Cap-and-Trade Program
Methodology and Summary Calculations
for Vintage 2013/2014 Allowance Allocation to Petroleum Refineries

This document describes the method used by the Air Resources Board to determine free allowance allocation to refineries during the first compliance period of the Cap-and-Trade Program. In November of 2012 and 2013, a total amount of vintage 2013 and vintage 2014 allowances, respectively, were allocated to the refining sector pursuant to section 95870(e) of the Cap-and-Trade Regulation (Regulation). This sector allocation was then distributed among individual refineries following the methods specified in section 95891(d) of the Regulation.

In the second and third compliance periods, beginning with vintage 2015 allowance allocation in October 2014, a product-based allocation approach will be used for refineries. Under this approach, allocation to each refinery will be calculated using the "complexity weighted barrel" (CWB) benchmark and refinery-reported CWB product data.

1. Overall Sector Allocation

The overall refinery sector allocation for each year in the first compliance period is based on a simple barrel benchmark. The overall sector allocation increases or decreases with the sector-wide production of primary refinery products in a manner that is consistent with the product-based allocation approach and directly comparable to other industrial sectors. The overall refinery sector allocation is calculated by the following equation:

$$SA_t = O_{t-2} \times B_R \times AF_{R,t} \times c_t$$

Where:

"SA_t" is the overall allocation to the refining sector for year "t";

"O_{t-2}" is the total output of primary refinery products from the refining sector in year "t-2" reported in barrels;

"B_R" is the simple barrel benchmark for primary refinery products, equal to 0.0462 allowances per barrel of primary refinery product;

"$AF_{R,t}$" is the assistance factor for year "t" assigned to petroleum refining as specified in Table 8-1; and

"c_t" is the cap adjustment factor for year "t" assigned to petroleum refining as specified in Table 9-2.

2. Distributing the Overall Sector Allocation to Individual Refiners

The overall sector allocation is distributed among individual facilities using two separate methods—one for facilities without a Solomon Energy Intensity Index (EII) value or with a non-representative EII value, and another for facilities with an EII value.

a. Facilities without EII Values or with Non-Representative EII Values

Refineries that do not have an EII value or have a non-representative EII value receive allowances based on either facility production or the facility historical emissions baseline.

i. Initial Allocation

The appropriate initial allocation formula is determined by the following inequality:

If: $O_{X,\mathrm{t}-2} \times B_R \times c_t \times AF_{R,\mathrm{t}} \leq BE_X \times c_t \times AF_{R,t}$

Then: $A_{X,\mathrm{t}} = O_{X,t-2} \times B_R \times c_t \times AF_{R,\mathrm{t}}$

Or if: $O_{X,\mathrm{t}-2} \times B_R \times c_t \times AF_{R,t} > BE_X \times c_t \times AF_{R,\mathrm{t}}$

Then: $A_{X,\mathrm{t}} = BE_X \times c_t \times AF_{R,\mathrm{t}}$

Where:

“$A_{X,t}$” is the allocation to refinery “X” without an EII value for year “t”;

“$O_{X,t-2}$” is the output of primary refinery products from refinery “X” in year “t-2” reported in barrels;

“B_R” is the benchmark for primary refinery products, equal to 0.0462 allowances per barrel of primary refinery product;

“c_t” is the adjustment factor for year “t” assigned to petroleum refining as specified in Table 9-2.

“$AF_{R,t}$” is the assistance factor for year “t” assigned to petroleum refining as specified in Table 8-1; and

"BE_X" is the baseline average annual greenhouse gas emissions for refinery "X" adjusted for steam purchases and sales, and for electricity sales.

The value of BE_X for a refinery is determined by the flowing equation:

$$BE_X = GHG + (S_{Purchased} - S_{Sold}) \times 0.06244 - e_{Sold} \times 0.431$$

Where:

"GHG" is the annual arithmetic mean greenhouse gas emissions from refinery "X" using 2008–2010 data;[1]

"$S_{Purchased}$" is the annual arithmetic mean amount of steam purchased by refinery "X" in MMBtu using 2008–2010 data;

"S_{Sold}" is the annual arithmetic mean amount of steam sold from refinery "X" in MMBtu using 2008–2010 data; and

"e_{Sold}" is the annual arithmetic mean amount of electricity sold from refinery "X" in MWh using 2008–2010 data.

ii. True-Up Allocation

In calendar years 2014 and 2015, previously calculated allowance allocations for petroleum refineries will be adjusted to account for actual 2013 and 2014 production. If a refinery received initial allowances based on output (*i.e.*, the first inequality above is satisfied and $A_{X,t}$ was calculated by the equation that includes the variable $O_{X,t-2}$), then the following equation is used to calculate the true-up allocation:

$$TrueUp_{X,t} = (O_{X,t-2} \times B_R \times c_{t-2} \times AF_{R,t-2}) - A_{X,t-2}$$

Where:

"$TrueUp_{X,t}$" is the amount of true-up allowances allocated to account for changes in production or allocation not properly accounted for in prior allocations for

[1] If the facility reported facility-level, third-party verified, greenhouse gas emissions data, including steam purchased and sold and electricity sold, to the California Climate Action Registry for data years 2006–2007, the Executive Officer considered these years in determining representative baseline values.

refinery "X." These allowances for budget year "t" may be used for compliance for budget year "t-2" and subsequent years; and

"$A_{X,t\text{-}2}$" is the initial allowance allocation to refinery "X" without an EII value for year "t-2."

If a refinery received its initial allocation based on emissions (i.e., the second inequality above is satisfied and $A_{X,t}$ was calculated by the equation that includes the variable BE_X), then the following true-up equation is used:

If: $AE_{X,t\text{-}2} < 0.8 \times BE_X$

Then: $TrueUp_{X,t} = (AE_{X,t\text{-}2} \times c_{t\text{-}2} \times AF_{R,t\text{-}2}) - A_{X,t\text{-}2}$.

Where:

"$AE_{X,t\text{-}2}$" is the covered greenhouse gas emissions for refinery "X" for the year "t-2," adjusted for steam purchases and sales, and for electricity sales, using the following equation:

$$AE_{X,t-2} = GHG_{t-2} + \left(S_{Purchased,t-2} - S_{Sold,t-2}\right) \times 0.06244 - e_{Sold,t-2} \times 0.431$$

Where:

"$GHG_{t\text{-}2}$" is the covered greenhouse gas emissions from refinery "X" in year "t-2";

"$S_{Purchased,t\text{-}2}$" is the amount of steam purchased by refinery "X" in year "t-2" in MMBtu;

"$S_{Sold,t\text{-}2}$" is the amount of steam sold from refinery "X" in year "t-2" in MMBtu; and

"$e_{Sold,t\text{-}2}$" is the amount of electricity sold from refinery "X" in year "t-2" in MWh.

For refineries where $AE_{X,t\text{-}2} \geq 0.8 \times BE_X$ no true-up allocation is provided.

b. Facilities with a Solomon Energy Intensity Index (EII) Value

For refineries that participated in the 2008 Solomon Energy Review and have a representative EII value, allowance allocation is determined using a methodology based on the following factors: (1) the historical emissions from each refinery (BE_Y), (2) the Solomon Energy Intensity Index (EII) for each refinery, (3) an adjustment factor (Adj_t) which reduces competitiveness impacts of allowance allocation among in-State refineries, (4) the ratio of total allocations to total emissions (F_t) for all refineries with an EII value, and (5) a refinery distribution factor ($DF_{Y,t}$).

i. Initial Allocation

The initial allocation of vintage 2013 and vintage 2014 allowances to individual refineries are calculated by the following equation:

$$A_{Y,t} = BE_Y \times DF_{Y,t} \times F_t$$

Where:

"$A_{Y,t}$" is the initial allocation to refinery "Y" that has an EII value for year "t";

"BE_Y" is the baseline average annual greenhouse gas emissions for refinery "Y" adjusted for steam purchases and sales, and for electricity sales;

"$DF_{Y,t}$" is the distribution factor; and

"F_t" is the ratio of the total allocations to total emissions for all refineries with an EII value.

The value of BE_Y for a refinery is determined by the flowing equation:

$$BE_Y = GHG + (S_{Purchased} - S_{Sold}) \times 0.06244 - e_{Sold} \times 0.431$$

Where:

"*GHG*" is the annual arithmetic mean greenhouse gas emissions from refinery "Y";

"$S_{Purchased}$" is the annual arithmetic mean amount of steam purchased by refinery "Y" in MMBtu;

"S_{Sold}" is the annual arithmetic mean amount of steam sold from refinery "Y" in MMBtu; and

"e_{Sold}" is the annual arithmetic mean amount of electricity sold from refinery "Y" in MWh.

These mean values are calculated using 2008-2010 data reported to ARB.[2]

The refinery distribution factor is calculated by the following equation:

$$DF_{Y,t} = ((Avg_t \,/\, EII_Y) + Adj_t) \,/\, (1 + Adj_t)$$

[2] If the facility reported facility-level, third-party verified, greenhouse gas emissions data, including steam purchased and sold and electricity sold, to the California Climate Action Registry for data years 2006–2007, the Executive Officer considered these years in determining representative baseline values.

Where:

"Avg_t" is the weighted average EII for year "t" for all facilities with EII values calculated by:

$$Avg_t = \frac{\sum BE_Y}{\sum(BE_Y/EII_Y)}$$

"EII_Y" is the Solomon Energy Intensity Index (EII) for refinery "Y" for 2008, 2009, or 2010 as determined to be representative by ARB's Executive Officer. For this calculation, values of EII_Y are rounded to one digit after the decimal; and

"Adj_t" is an adjustment factor for year "t" that provides the facility with the best EII the highest ratio of allowances to baseline emissions, and is calculated by:

$$Adj_t = \frac{[(Avg/EII_{Best}) \times F_t - 1]}{(1 - F_t)}$$

Where "EII_{Best}" is the EII value of the most efficient facility (*i.e.*, the lowest EII value in the sector).

The fraction "F_t" is calculated by the following equation:

$$F_t = \frac{SA_t - \sum A_{X,t}}{\sum BE_Y}$$

Where:

$\Sigma A_{X,t}$ is the sum of all allowance allocations to refineries without an EII value for the year "t"; and

"SA_t" is the allocation to the refining sector for year "t."

Under this calculation approach, the facility with the best (most efficient) EII receives an allowance allocation that covers the greatest fraction of their historical baseline emissions. Less efficient facilities receive allowance allocations that are smaller fractions of their historic baseline emissions. A true-up allocation accounting for actual emissions occurs after the end of the compliance period to ensure that there is no excessive under- or over-allocation.

ii. True-Up Allocation

If the sum of actual 2013 and 2014 emissions from a refinery is less than its total allowance allocation for those years, then the entity has its vintage 2016 allowance allocation reduced according to the following true-up debit equation:

If: $(AE_{Y,2013} + AE_{Y,2014}) < (\mathrm{A}_{Y,2013} + \mathrm{A}_{Y,2014})$

Then: $\mathrm{A}_{Y,Debit} = 0.8 \times \left[(AE_{Y,2013} + AE_{Y,2014}) - (\mathrm{A}_{Y,2013} + \mathrm{A}_{Y,2014})\right]$

Where:

"$AE_{Y,t}$" is the actual GHG emissions from a facility in year "t" adjusted for steam sales and purchases, and for electricity sales; and

"$A_{Y,Debit}$" is the amount of true-up allowances allocated from budget year 2016 to account for changes in production or allocation not properly accounted for in prior allocations to refinery "Y."

If the sum of actual 2013 and 2014 emissions from a refinery is greater than double its baseline emissions, then the entity will be provided additional vintage 2016 allowances according to the following true-up credit equation:

If: $(2 \times BE_Y) < (AE_{Y,2013} + AE_{Y,2014})$

Then: $\mathrm{A}_{Y,Credit} = (AE_{Y,2013} \times DF_{Y,2013} \times F_{2013} \times AF_{2013} + AE_{Y,2014} \times DF_{Y,2014} \times F_{2014} \times AF_{2014}) - (\mathrm{A}_{Y,2013} + \mathrm{A}_{Y,2014})$

Where:

"$A_{Y,Credit}$" is the amount of true-up allowances allocated from budget year 2016 to account for changes in production or allocation not properly accounted for in prior allocations to refinery "Y." These allowances will be eligible to be used for compliance for budget year 2013 and subsequent years.

3. Summary Calculations for Initial Allocation of Vintage 2013 Allowances

The values of factors used to determine vintage 2013 allowance allocation for refineries are presented here.

1) The value of SA_{2013} was calculated to be 29,163,759 allowances by the following equation:

$$SA_{2013} = O_{2011} \times B_R \times AF_{R,2013} \times c_{2013}$$

Where:

O_{2011} = 643,476,243 barrels of primary refinery product;

B_R = 0.0462 allowances per barrel of primary refinery product;

$AF_{R,2013}$ = 1; and

c_{2013} = 0.981.

2) The value[3] of Adj_{2013} was calculated to be 0.423455 using the following equation:

$$Adj_{2013} = \frac{[(Avg_{2013}/EII_{Best}) \times F_{2013} - 1]}{(1 - F_{2013})}$$

Where EII_{Best} = 79.0, and values of F_{2013} and Avg_{2013} are presented below.

3) The value[3] of F_{2013} was calculated to be 0.886867 using the following equation:

$$F_{2013} = \frac{SA_{2013} - \sum A_{X,2013}}{\sum BE_Y}$$

Where SA_{2013} = 29,163,759 allowances, and values for $\Sigma A_{X,2013}$ and ΣBE_Y are withheld to protect confidential business information.

4) The value[3] of Avg_{2013} was calculated to be 93.344987 using the following equation:

$$Avg_{2013} = \frac{\sum BE_Y}{\sum (BE_Y/EII_Y)}$$

Where values for ΣBE_Y and $\Sigma(BE_Y / EII_Y)$ are withheld to protect confidential business information.

4. Summary Calculations for Initial Allocation of Vintage 2014 Allowances

The values of factors used to determine vintage 2014 allowance allocation for refineries are presented here.

1) The value of SA_{2014} was calculated to be 28,424,228 allowances by the following equation:

$$SA_{2014} = O_{2012} \times B_R \times AF_{R,2014} \times c_{2014}$$

[3] Rounded to six decimal places here, but not rounded in actual allocation calculations.

Where:

O_{2012} = 638,881,647 barrels of primary refinery product;

B_R = 0.0462 allowances per barrel of primary refinery product;

$AF_{R,2014}$ = 1; and

c_{2014} = 0.963.

2) The value[4] of Adj_{2014} was calculated to be 0.169631 using the following equation:

$$Adj_{2014} = \frac{[(Avg_{2014}/EII_{Best}) \times F_{2014} - 1]}{(1 - F_{2014})}$$

Where EII_{Best} = 79.0, and values of F_{2014} and Avg_{2014} are determined as described below.

3) The value[4] of F_{2014} was calculated to be 0.864575 using the following equation:

$$F_{2014} = \frac{SA_{2014} - \sum A_{X,2014}}{\sum BE_Y}$$

Where SA_{2014} = 28,424,228 allowances, and values for $\Sigma A_{X,2014}$ and ΣBE_Y are withheld to protect confidential business information.

4) The value[4] of Avg_{2014} was calculated to be 93.473437 using the following equation:

$$Avg_{2014} = \frac{\sum BE_Y}{\sum (BE_Y/EII_Y)}$$

Where values for ΣBE_Y and $\Sigma(BE_Y / EII_Y)$ are withheld to protect confidential business information.

[4] Rounded to six decimal places here, but not rounded in actual allocation calculations.