Cap-and-Trade Regulation
Industry Assistance Factor Calculation
Addendum to October 21, 2016 Informal Staff Proposal

Together, Assembly Bill 32 (AB 32), Senate Bill 32, and Assembly Bill 197 set an ambitious goal for reducing greenhouse emissions to 40 percent below 1990 levels by 2030 and provide guidance for how those reductions are achieved. To meet these objectives, the State is developing a 2030 Target Scoping Plan to chart the path to achieve the 2030 limit. Comments received on the 2030 Target Scoping Plan and Cap-and-Trade Regulation (Regulation) rulemaking materials will be considered as staff prepares a final Regulation for Board consideration in 2017.

In 2011 and 2012, Board Resolutions 11-32 and 12-33 directed Air Resources Board (ARB) staff to investigate potential improvements to industrial allowance allocation to better meet the AB 32 objective to "minimize emissions leakage to the extent feasible." In response, ARB commissioned three emissions leakage potential studies to inform the development of assistance factors (AF) for Cap-and-Trade Program allowance allocation to manufacturing sectors. Based on these leakage studies, ARB staff proposed in Appendix E[1] of the 2016 Initial Statement of Reasons to the proposed amendments to the Regulation a methodology by which emissions leakage would be assessed and AFs would be developed for the fourth compliance period and beyond. A paper entitled "October 21, 2016 Industrial Assistance Factor Calculation: Informal Staff Proposal" (October 21 informal staff proposal)[2] was published on October 21, 2016, listing post-2020 AFs for the sectors that were analyzed in the commissioned studies.

Staff planned to use public data to calculate post-2020 AFs for sectors not included in the leakage studies. These sectors include all mining sectors (i.e., NAICS codes listed in table 8-1 of the Regulation[3] that start with "2"); wet corn milling (NAICS 311221); cyclic crude, intermediate, and gum and wood chemical manufacturing (NAICS 325194); other motor vehicle parts manufacturing (NAICS 336390); and support activities for air transportation (NAICS 4881). Before publishing the October 21 informal staff proposal, however, staff identified an inconsistency in the data planned for use—specifically, the 2007 domestic exports from the U.S. Census Bureau's USA Trade Online database[4] exceeded the 2007 U.S. Economic Census'[5] domestic shipments (inclusive of domestic exports and shipments for domestic consumption) for the rare earth mining sector (NAICS 212299). Staff has identified and resolved the cause of the inconsistency, which was the use of an incorrect column of the 2007 Economic Census for domestic shipments in non-studied sectors with NAICS codes starting with "2," and is now releasing AFs calculated using public U.S. Census and trade data, as originally planned. This addendum to the informal staff proposal includes these AFs and

[1] https://www.arb.ca.gov/regact/2016/capandtrade16/appe.pdf
[2] https://www.arb.ca.gov/cc/capandtrade/meetings/20161021/ct-af-proposal-102116.pdf. A prior version of the proposal was posted on October 14, 2016. The October 21 proposal includes updated (and accurate) versions of Tables 3–6.
[3] https://www.arb.ca.gov/cc/capandtrade/capandtrade/unofficial_ct_030116.pdf
[4] https://usatrade.census.gov/
[5] https://www.census.gov/econ/census/

publishes the details supporting their calculation for stakeholder review and feedback to inform the formal 15-day regulatory amendments. Staff requests feedback on this proposed methodology for the aforementioned sectors by 5 pm on Wednesday, November 23, 2016. A website for comments will be available the week of November 14, 2016 and linked to from https://www.arb.ca.gov/cc/capandtrade/meetings/meetings.htm.

Potential Emissions Leakage for Sectors Not Evaluated by the Studies

Overview

The leakage studies referenced in the October 21 informal staff proposal analyzed potential industrial emissions leakage risk for most manufacturing sectors covered by the Cap-and-Trade Program (i.e., most sectors assigned a NAICS code starting with 3). Non-manufacturing sectors with NAICS codes starting with 1, 2, and 4 were not analyzed by these studies. Because raw international market transfer (IMT), value added domestic drop (DD), and output DD values for these non-studied sectors are unavailable, emissions leakage potentials for these sectors were estimated by matching each non-studied sector based on its energy intensity and trade exposure using the processes described below.

International AF Component for Non-Studied Sectors

For the international AF component (IMT) of a non-studied sector, publicly available six-digit NAICS value added data from the 2007 and 2012 U.S. Census and USA Trade Online import and export data[6] are combined to calculate an average energy intensity and trade exposure). The energy intensity and trade exposure are then used to calculate an IMT value using equation 4 of the October 21, 2016 informal staff proposal. Table 1 lists the energy intensities, trade exposure values, and IMTs for the non-studied sectors that were determined using this method. The calculated IMT values are set equal to the international AF component for these sectors.

Domestic AF Component for Non-Studied Sectors

The domestic study analyzed the responsiveness in output and value added to changes in electricity and natural gas prices. This responsiveness was used to measure the effect of a carbon signal on domestic leakage. Responsiveness is driven in part by the fraction of total costs coming from energy consumption; this fraction is called “energy intensity.” The greater the sector-specific energy intensity, the greater the sector-specific cost impact of a carbon signal.

[6] USA Trade Online: total NAICS six-digit level exports and CIF imports values. CIF (cost, insurance, freight) imports is the “landed value of the merchandise at the first port of arrival in the United States. It is computed by adding import charges to the Customs value and therefore excludes U.S. import duties.” (USA Trade Online glossary of terms, available through log-in at https://usatrade.census.gov/)

Two domestic drop measures used for determining the domestic AF component for studied sectors use a regression approach of the study's domestic drop measurements on energy intensity. The methodologies of these regressions and their subsequent domestic drop calculations can be found in the October 21 informal staff proposal.

The publicly available 2007 and 2012 U.S. Census data reports electricity costs and the combined sum of costs from other fuels (e.g., natural gas, coal and coke). By not breaking out natural gas costs from other fuels, the energy intensity reported in the domestic study (natural gas and electricity fuels only) cannot be directly compared to the energy intensity reported in the U.S. Economic Census (with other fuels). Energy intensity, if compared directly, would be higher for non-studied sectors than sectors covered by the domestic study, simply through the inclusion of alternate fuel consumption (e.g., coal consumption). Therefore, to ensure comparability, the U.S. Census data for both the studied and non-studied sectors is used for the measurement of energy intensity in the following formulas. These formulas develop two estimates of domestic drops (domestic value added drop and domestic output drop) for the studied and non-studied sectors based on energy cost intensities that are directly comparable. Domestic value added drops for the non-studied sectors determined in this manner are presented in Table 2. The domestic output drops for the non-studied sectors can be found in Table 3.[7]

Domestic value added drop and U.S. Census energy intensity are correlated for the manufacturing sector using a pooled linear regression (OLS):

$$DVA_{i,manufacturing,0} = B_0 + B_1 \times \ln(\text{U.S. Census energy intensity}_i) + \text{error}_i \quad \text{(Equ. 1)}$$

Where:

"$DVA_{i,manufacturing,0}$" is the domestic value added drop for manufacturing sector "i" with zero assistance factor from the domestic study, which can be found in Table 3 of the October 21, 2016 informal staff proposal, and

"U.S. Census energy intensity" is the energy intensity for the manufacturing sector determined from the U.S. Census data.

Each non-studied sector's regressed domestic value added drop with a zero assistance factor is then calculated by the following equation:

$$DVA_{j,regressed,0} = estB_0 + estB_1 \times \ln(\text{U.S. Census energy intensity}_j) \quad \text{(Equ. 2)}$$

[7] Wet corn milling (NAICS Code 311221) was not covered by the domestic study, so estimates of wet corn milling domestic drop used the same process as non-manufacturing sectors.

Where:

"$DVA_{j,regressed,0}$" is the regression domestic value added drop for non-studied sector "j" with a zero assistance factor, which is presented as the third column (0AF column) in Table 2, and

"$estB_k$" is the OLS estimate of the coefficient B_k resulting from equation 1.

The regressed domestic value added drop with increasing assistance factors for each non-studied sector "j" is calculated by the following equation:

$$DVA_{j,regressed,X} = DVA_{j,regressed,0} \times (1 - X) \quad \text{(Equ. 3)}$$

Where:

"$DVA_{j,regressed,X}$" is the regression domestic value added drop for non-studied sector "j" with an assistance factor equal to X, where X is one of the various AF values reported in the columns of Table 2.

The relationship between domestic output drop and U.S. Census energy intensity for non-studied sectors is determined in the same manner as for domestic value added drop, by using a pooled linear regression (OLS):

$$\text{Output Drop}_{i,manufacturing,0} = B_0 + B_1 \times \ln(\text{U.S. Census energy intensity}_i) + \text{error}_i \quad \text{(Equ. 4)}$$

Where:

"Output $Drop_{i,manufacturing,0}$" is the domestic output drop for manufacturing sector "i" with zero assistance factor from the domestic study, which can be found in Table 4 of the October 21, 2016 informal staff proposal, and

"U.S. Census energy intensity" is the energy intensity for the manufacturing sector determined from the U.S. Census data.

Each non-studied sector's regressed domestic output drop with a zero assistance factor is then calculated by the following equation:

$$\text{Output Drop}_{j,regressed,0} = estB_0 + estB_1 \times \ln(\text{U.S. Census energy intensity}_j) \quad \text{(Equ. 5)}$$

Where:

"Output $Drop_{j,regressed,0}$" is the regression domestic output drop for non-studied sector "j" with zero assistance factor, which is presented in Table 3, and

"estB_k" is the OLS estimate of the coefficient B_k resulting from equation 4.

The regressed domestic output drop with increasing assistance factors for each non-studied sector "j" is calculated by the following equation:

$$\text{Output Drop}_{j,\text{regressed},X} = \text{Output Drop}_{j,\text{regressed},0} \times (1 - X) \quad \text{(Equ. 6)}$$

Where:

"Output $\text{Drop}_{j,\text{regressed},X}$" is the regression domestic output drop for non-studied sector "j" with an assistance factor equal to X, where X is one of the various AF values reported as the third column (0AF column) in the columns of Table 3.

Table 2 and 3, as well as the -10.245 percent DD cutoff value (7 percent DD using 2022 auction reserve price applied to the tables at the higher 2030 auction reserve price), are applied to develop two domestic AF component estimates for each non-studied sector. For each sector, the final domestic AF component was assigned to be the average of the two determined domestic AF components. This can be found in Table 4.

Potential Emissions Leakage for Sectors with Non-Purchased Fuels and/or Process Emissions Not Evaluated by the Studies

The oil and gas extraction (NAICS code 211111) and natural gas processing (NAICS code 211112) sectors have emissions from activities not directly associated with the burning of purchased fuels (e.g., non-purchased fuels). The U.S. Census energy intensities for these sectors were adjusted upward to account for these emissions in the same way that energy intensities were adjusted for other sectors with non-purchased fuel and/or process emissions:

$$\text{Revised energy intensity} = \text{Census energy intensity} / F \quad \text{(Equ. 7)}$$

Where:

"Census energy intensity" is the energy intensity for these sectors calculated by the U.S. Census; and

"F" is the fraction of total emissions from the consumption of purchased fuels divided by covered emissions based on MRR data.

The determination of IMTs and DDs for these sectors otherwise followed the methodology of non-studied sectors without process emissions and/or emissions associated with non-purchased fuels. Adjusting for these emissions slightly increased the calculated IMT and DDs for these sectors. Table 5 provides the fraction of total emissions from consumption of purchased fuel for these sectors. The portion of emissions not from the consumption of purchased fuel is classified as process emissions in this determination.

Domestic Assistance Factor Component for Non-Studied Sectors

Table 4 lists the two domestic AF components determined by each of the two regression DD approaches for non-studied sectors, and the table also identifies the average of these two domestic AF components, which is the one used in equation 8 to determine the total AF found in Table 6 (i.e., the post-2020 AFs).

Total AF = Domestic AF Component + International AF Component (Equ. 8)

Where:

"Domestic AF Component" is the portion of the post-2020 AF used to minimize domestic leakage; and

"International AF Component" is the portion of the post-2020 AF used to minimize international leakage.

Future Non-Studied Sectors

Should a covered entity start to operate in an industrial sector that is not currently assigned an AF, staff proposes assigning an assistance factor to the new sector using the methodology developed for the non-studied sectors.

Table 1. Non-studied sector IMT characteristics.

NAICS Code	NAICS Sector Definition	Trade Exposure	Energy Intensity	International Assistance Factor Component
211111	Crude Petroleum and Natural Gas Extraction	0.56	0.05	0.41
211112	Natural Gas Liquid Extraction	0.20	0.03	0.16
212299	All Other Metal Ore Mining	0.83	0.10	0.55
212391	Potash, Soda, and Borate Mineral Mining	0.01	0.17	0.03
212399	All Other Nonmetallic Mineral Mining	0.71	0.12	0.50
311221	Wet Corn Milling	0.23	0.10	0.19
325194	Cyclic Crude, Intermediate, and Gum and Wood Chemical Manufacturing	0.44	0.05	0.33
336390	Other Motor Vehicle Parts Manufacturing	0.54	0.01	0.40
4881	Support Activities for Air Transportation	0.00	0.03	0.02

Table 2. Regressed domestic value added DD for each non-studied sector at assistance factors from zero to 90 percent (percentages).

NAICS Code	NAICS Sector Definition	0AF	10AF	20AF	30AF	40AF	50AF	60AF	70AF	80AF	90AF
211111	Crude Petroleum and Natural Gas Extraction	-13.5	-12.1	-10.8	-9.4	-8.1	-6.7	-5.4	-4.0	-2.7	-1.3
211112	Natural Gas Liquid Extraction	-10.9	-9.8	-8.7	-7.6	-6.6	-5.5	-4.4	-3.3	-2.2	-1.1
212299	All Other Metal Ore Mining	-16.6	-14.9	-13.3	-11.6	-10.0	-8.3	-6.6	-5.0	-3.3	-1.7
212391	Potash, Soda, and Borate Mineral Mining	-18.8	-16.9	-15.0	-13.2	-11.3	-9.4	-7.5	-5.6	-3.8	-1.9
212399	All Other Nonmetallic Mineral Mining	-17.3	-15.6	-13.9	-12.1	-10.4	-8.7	-6.9	-5.2	-3.5	-1.7
311221	Wet Corn Milling	-16.6	-14.9	-13.2	-11.6	-9.9	-8.3	-6.6	-5.0	-3.3	-1.7
325194	Cyclic Crude, Intermediate, and Gum and Wood Chemical Manufacturing	-13.3	-12.0	-10.7	-9.3	-8.0	-6.7	-5.3	-4.0	-2.7	-1.3
336390	Other Motor Vehicle Parts Manufacturing	-6.4	-5.7	-5.1	-4.5	-3.8	-3.2	-2.5	-1.9	-1.3	-0.6
4881	Support Activities for Air Transportation	-11.2	-10.1	-9.0	-7.9	-6.7	-5.6	-4.5	-3.4	-2.2	-1.1

Table 3. Regressed public output DD for each non-studied sector at assistance factors from zero to 90 percent (percentages).

NAICS Code	NAICS Sector Definition	0AF	10AF	20AF	30AF	40AF	50AF	60AF	70AF	80AF	90AF
211111	Crude Petroleum and Natural Gas Extraction	-14.2	-12.8	-11.3	-9.9	-8.5	-7.1	-5.7	-4.3	-2.8	-1.4
211112	Natural Gas Liquid Extraction	-11.8	-10.6	-9.4	-8.2	-7.1	-5.9	-4.7	-3.5	-2.4	-1.2
212299	All Other Metal Ore Mining	-17.1	-15.4	-13.7	-12.0	-10.3	-8.6	-6.8	-5.1	-3.4	-1.7
212391	Potash, Soda, and Borate Mineral Mining	-19.2	-17.3	-15.4	-13.4	-11.5	-9.6	-7.7	-5.8	-3.8	-1.9
212399	All Other Nonmetallic Mineral Mining	-17.8	-16.0	-14.2	-12.5	-10.7	-8.9	-7.1	-5.3	-3.6	-1.8
311221	Wet Corn Milling	-17.1	-15.4	-13.7	-12.0	-10.2	-8.5	-6.8	-5.1	-3.4	-1.7
325194	Cyclic Crude, Intermediate, and Gum and Wood Chemical Manufacturing	-14.1	-12.6	-11.2	-9.8	-8.4	-7.0	-5.6	-4.2	-2.8	-1.4
336390	Other Motor Vehicle Parts Manufacturing	-7.5	-6.7	-6.0	-5.2	-4.5	-3.7	-3.0	-2.2	-1.5	-0.7
4881	Support Activities for Air Transportation	-12.0	-10.8	-9.6	-8.4	-7.2	-6.0	-4.8	-3.6	-2.4	-1.2

Table 4. Non-studied sector domestic assistance factor component from two regression DD approaches and assigned domestic assistance factor component.

NAICS Code	NAICS Sector Definition	Non-Manufacturing Output Regression Domestic AF Component	Non-Manufacturing Value Added Regression Domestic AF Component	Assigned Domestic Assistance Factor Component
211111	Crude Petroleum and Natural Gas Extraction	0.3	0.3	0.3
211112	Natural Gas Liquid Extraction	0.2	0.1	0.15
212299	All Other Metal Ore Mining	0.5	0.4	0.45
212391	Potash, Soda, and Borate Mineral Mining	0.5	0.5	0.5
212399	All Other Nonmetallic Mineral Mining	0.5	0.5	0.5
311221	Wet Corn Milling	0.5	0.4	0.45
325194	Cyclic Crude, Intermediate, and Gum and Wood Chemical Manufacturing	0.3	0.3	0.3
336390	Other Motor Vehicle Parts Manufacturing	0	0	0
4881	Support Activities for Air Transportation	0.2	0.1	0.15

Table 5. Fraction of total emissions from consumption of purchased fuels for non-studied sectors with non-purchased emissions.

NAICS Code	NAICS Sector Definition	Fraction of Total Emissions from Consumption of Purchased Fuels
211111	Crude Petroleum and Natural Gas Extraction	66%
211112	Natural Gas Liquid Extraction	31%

Table 6. Compliance period 3 assistance factors, domestic assistance factor component, international assistance factor component, and post-2020 assistance factors for non-studied sectors.

NAICS	Activity Name	Compliance Period 3 AF	Domestic AF Component	International AF Component	Post-2020 AF
211111	Crude Petroleum and Natural Gas Extraction	1	0.3	0.41	0.71
211112	Natural Gas Liquid Extraction	1	0.15	0.16	0.31
212299	All Other Metal Ore Mining	1	0.45	0.55	1.00
212391	Potash, Soda, and Borate Mineral Mining	1	0.5	0.03	0.53
212399	All Other Nonmetallic Mineral Mining	1	0.5	0.50	1.00
311221	Wet Corn Milling	1	0.45	0.19	0.64
325194	Cyclic Crude, Intermediate, and Gum and Wood Chemical Manufacturing	1	0.3	0.33	0.63
336390	Other Motor Vehicle Parts Manufacturing	0.5[8]	0	0.40	0.40
4881	Support Activities for Air Transportation	0.5	0.15	0.02	0.17

[8] If new section 95891(a)(1) of the proposed Regulation (https://www.arb.ca.gov/regact/2016/capandtrade16/appa.pdf) is approved by the Board.