MODELING FOR INTER-POLLUTANT AND INTER-BASIN CREDIT USAGE IN TEXAS

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Introduction and Background

Nonattainment New Source Review (NNSR) permitting projects in Texas' two ozone nonattainment areas, Dallas-Fort Worth (DFW) and Houston-Galveston-Brazoria (HGB), are required to offset emissions increases in ozone precursors (nitrogen oxides (NO_x) and/or Volatile Organic Compounds (VOC)) with reductions from existing or previously existing sources within the same nonattainment area.

Inter-Basin (IB) Credit Use: When credits[b] from one nonattainment area are used to offset emissions in another nonattainment area, i.e., HGB credits used to offset emissions in DFW or DFW credits used to offset emissions in HGB.

Inter-Pollutant (IP) Credit Use: When credits of one ozone precursor are used to offset emissions of another ozone precursor, i.e., NO_x credits for VOC emissions or VOC credits for NO_x emissions.

The TCEQ's modeling procedure for IB/IP credit use relies on using photochemical modeling to demonstrate that the credits used sufficiently offset emissions from the new source[a]

Criteria for demonstrating credits sufficiently offset emissions:

- Relative impact of the credits is greater than the relative impact of the project emissions on ozone formation in the nonattainment area where the project is located.
- No detriment to the attainment demonstration (AD) state implementation plan (SIP) in the nonattainment area where the project is located.

The modeling procedure includes a minimum of three photochemical model runs followed by comparative analysis.

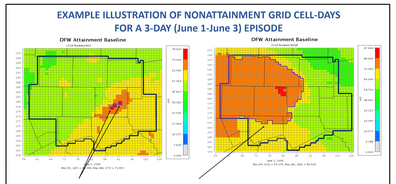
a: For non-IP/IB credit offsets such a demonstration is not required since it is assumed (by the Clean Air Act) that a ton-for-ton swap of credits of the same pollutant from the same nonattainment area sufficiently offsets the new emissions.
b: Credits are banked emissions reductions that are traded on the open market.

Modeling Procedure

The Attainment Baseline (AB) Case

- Replicate the **future year** photochemical modeling for the latest AD SIP for the nonattainment area where the project is to be located.
- Keep the emissions inventory (EI) and meteorology same as the AD SIP.
- Identify the subset of grid cells within the nonattainment area with modeled Maximum Daily Average Eight-Hour (MDA8) ozone concentration greater than 70 ppb for each modeled day (nonattainment grid cell-days).

EXAMPLE ILLUSTRATION OF NONATTAINMENT GRID CELL-DAYS FOR A 3-DAY (June 1-June 3) EPISODE



LEGEND

Outline of DFW Nonattainment Area

Outline of Nonattainment Grid Cells for a specific episode day

The Credit Baseline (CB) Case

Add emissions equivalent to the IB/IP credits (CB_{EI}) that are to be used to offset project emissions to the AB case EI and run the model. The impact of the credits on ozone formation is quantified as follows:

$$E_C = \sum_{n=1}^{N} (OC_n - OA_n)$$

where:

n: Nonattainment grid cell-day
N: Total number of nonattainment grid cell-days
OA_n: Modeled MDA8 ozone concentration in the AB case for each n
OC_n: Modeled MDA8 ozone concentration in the CB case for each n
E_C: Credit Effect, i.e., the effect of the CB case on MDA8 ozone concentrations

The Project Baseline (PB) Case

Add project emissions (PB_{EI}) to the AB case EI run the model. The impact of the project on ozone formation is quantified as follows:

$$E_P = \sum_{n=1}^{N} (OP_n - OA_n)$$

where:

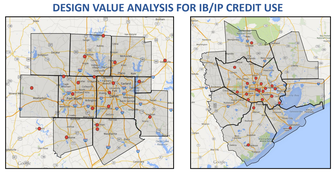
n: Nonattainment grid cell-day
N: Total number of nonattainment grid cell-days
OA_n: Modeled MDA8 ozone concentration in the AB case for each n
OP_n: Modeled MDA8 ozone concentration in the PB case for each n
E_P: Project Effect, i.e., the effect of the PB case on MDA8 ozone concentrations.

Comparative Analysis

Overall Air Quality Analysis for the Nonattainment Area: In the nonattainment area where the project is located, the effect (IB_E or IP_E) of the IB/IP credit use is the difference between the Credit Effect (E_C) and the Project Effect (E_P).

Monitor Design Value Analysis: For relevant monitors in the nonattainment area where the project is located, the monitor specific effect (IB_m or IP_m) of IB/IP credit use is the difference between the CB case modeled future design value (DVC_m) and the PB case modeled future design value (DVP_m).

LOCATION OF REGULATORY MONITORS USED IN MONITOR DESIGN VALUE ANALYSIS FOR IB/IP CREDIT USE



DFW NONATTAINMENT AREA | HGB NONATTAINMENT AREA

- The monitor design analysis is done for each monitor in the AB case with future design values greater than or equal to 70 parts per billion (ppb).
- The selection criteria of 70 ppb was chosen as it is 5 ppb less than current 2008 eight-hour ozone National Ambient Air Quality Standard and since it is not necessary to consider the effect of the IB/IP use of credits on monitors that pose a negligible risk to an area's attainment status.

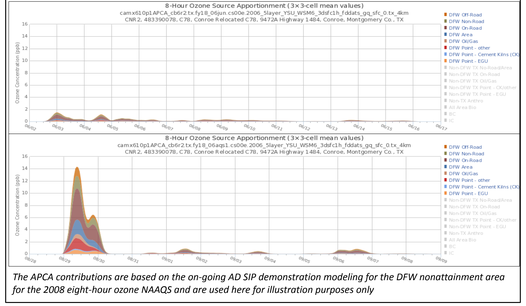
Differences in Modeling and Approval of IB and IP Credit Use

IB Credit Use	IP Credit Use
CB Case facility location: A facility with the same physical location, stack parameters, and chemical speciation is located where the original reductions occurred.	***CB Case facility location:*** A facility with the same stack parameters and chemical speciation as the facility from which the credit originated is located within a one-kilometer radius of the project location centroid.
Criteria for Approval of IB Credit Use: $IB_E > 0$ and $IB_M \geq 0$	***Criteria for Approval of IP Credit Use:*** $IP_E \geq 0$ and $IP_M \geq 0$

Additional Condition for IB Credit Use

A demonstration is made that the emissions from the nonattainment area where the credit is generated contribute to a violation of the National Ambient Air Quality Standard (NAAQS) in the nonattainment area where the project is located. One of the approaches for the demonstration is to use Anthropogenic Precursor Culpability Assessment (APCA) to identify the contributions of emissions sources in one nonattainment area to another nonattainment area.

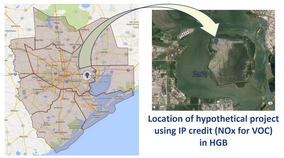
ILLUSTRATION OF APCA OZONE CONTRIBUTION AT ONE MONITOR IN HGB DUE TO DFW EMISSION SOURCES



The APCA contributions are based on the on-going AD SIP demonstration modeling for the DFW nonattainment area for the 2008 eight-hour ozone NAAQS and are used here for illustration purposes only

IP Credit Use Illustrative Example 1: Effect of VOC Reactivity on IP Credit Use in HGB

To illustrate the impact of speciation and associated reactivity of project emissions on IP credit use, hypothetical test scenarios were modeled where 100 tons per year (tpy) of NO_x credits (CB_{EI}) were used to offset 100 tpy of project VOC emissions (PB_{EI}) with differing total weighted maximum incremental reactivity (TWMIR).



Location of hypothetical project using IP credit (NOx for VOC) in HGB

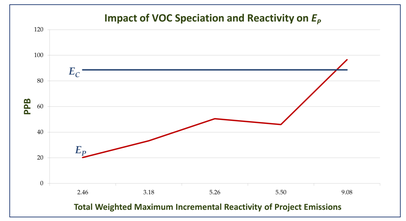
PB Case Description	VOC Speciation	Scenario
A boiler with a TWMIR of 3.1802	EPA SPECIATE Profile 0004	hvbp1
A boiler with a TWMIR of 2.46	EPA SPECIATE Profile 0003	hvbp2
A boiler with a TWMIR of 5.50	Sample Chemical Refinery	hvbp3
A flare with a TWMIR of 5.26	EPA SPECIATE Profile 0079	hvfp4
A boiler with a TWMIR of 9.08	100% Ethylene	hvbp5

Summary of Results for Illustrative Example 1:

Scenario	E_P (ppb)	IP_E (ppb) $(E_C - E_P)$	Approval Criteria Met	IP_{ratio} $(\frac{CB_{EI}}{PB_{EI}})$	Total Credits Retired $(CB_{EI} \times Offset\ Ratio)$	IP_{ratio} (Unit ton of Ozone Precursor Basis) $\left(\frac{E_C}{CB_{EI}}\right)/\left(\frac{E_P}{PB_{EI}}\right)$
hvbp1	33.27528	55.3180	✓	1	130 tpy	2.66
hvbp2	20.24886	68.3444	✓	1	130 tpy	4.38
hvbp3	45.97251	42.6208	✓	1	130 tpy	1.93
hvfp4	50.50556	38.0877	✓	1	130 tpy	1.75
hvbp5	96.56713	-7.9739	×	N/A	N/A	0.92

- A total of **16,067** (N) nonattainment grid cell-days were identified in the AB case in HGB.
- The Credit Effect (E_C) was **88.5933 ppb**.
- $IP_m \geq 0$ for all monitors for scenarios hvbp1, hvbp2, hvbp3, and hvfp4. For scenario hvbp5, $IP_m < 0$ for one monitor.

100 tons of NO_x credits were used to cover 100 tons of VOC emissions in each test scenario, however the effect on the air quality varies significantly depending on the speciation and reactivity of the VOC emissions.

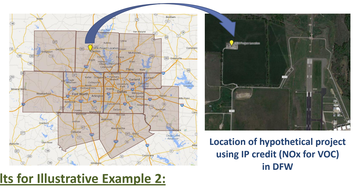


- For scenario hvbp5, since the effect of the credit is less than the effect of the project emissions, for approval of IP credit use, the applicant will have to retire additional credits.
- For scenarios hvbp1, hvbp2, hvbp3, and hvfp4, since the effect of the credit is much greater than the effect of the project emissions, the applicant could retire less credits that initially modeled.

If the applicant chooses to alter the amount of credits and/or project emissions, the CB case and/or PB case, model runs will have to be re-run to verify that the credits are sufficient to offset the project emissions.

IP Credit Use Illustrative Example 2: Effect of Amount of Credits Used in DFW

To illustrate the impact of the amount of credits on IP credit use, hypothetical test scenarios with different amounts of NOx credits were used to offset 227 tpy of VOC project emissions (PB_{EI}).



Location of hypothetical project using IP credit (NOx for VOC) in DFW

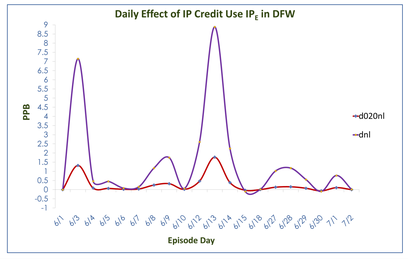
Summary of Results for Illustrative Example 2:

Scenario	E_C (ppb)	IP_E (ppb) $(E_C - E_P)$	Approval Criteria Met	IP_{ratio} $(\frac{CB_{EI}}{PB_{EI}})$	Total Credits Retired $(CB_{EI} \times Offset\ Ratio)$	IP_{ratio} (Unit ton of Ozone Precursor Basis) $\left(\frac{E_C}{CB_{EI}}\right)/\left(\frac{E_P}{PB_{EI}}\right)$
100 tpy of NO_x (dnl)	29.05052	28.39039	✓	0.08	120 tpy	99.32
20 tpy of NO_x (d020nl)	5.79412	5.13399	✓	0.44	24 tpy	98.09

- A total of **7,484** (N) nonattainment grid cell-days were identified in the AB case in DFW.
- The Project Effect (E_P) was **0.66013 ppb**.
- $IP_m \geq 0$ for all monitors for both scenarios.

Illustration of Daily Effect of IP Credit Use

The "Overall Air Quality Analysis" for the nonattainment area calculates the effect of IP credit use across all modeled episode days. However, the effect of IP credit use varies across days.



Conclusion

- The modeling procedure for IB/IP credit use is flexible and robust. The procedure and required analysis accounts for the following key factors:
  - ❑ Impact of project emissions reactivity.
  - ❑ Impact of project location.
  - ❑ The non-linear relationship between ozone and its precursors.
- The modeling demonstration also ensures that there is no detriment to the AD SIP in the nonattainment where the project is located in two ways:
  - ❑ Using the latest future year AD SIP modeling as the baseline and measuring the impact of the credits and projects relative to the AD SIP modeling.
  - ❑ Ensuring that there is no increase to the future year design value.
- In case of IP credit use, while the modeling procedure verifies that the amount (tons) of credits is sufficient to offset the project emissions, applicants can use the procedure to also determine the amount of credits needed as IP offsets.

References:

1. TCEQ, January 2014, "*Guidance on the Inter-Pollutant Use of Credits for Nonattainment New Source Review Permit Offset Requirements.*"
2. TCEQ, January 2014, "Guidance on the Inter-Basin Use of Credits for Nonattainment New Source Review Permit Offset Requirements."
3. EPA, April 2007, *Guidance on the Use of Models and Other Analyses for Demonstrating Attainment of Air Quality Goals for Ozone, PM2.5, and Regional Haze* (EPA-454/B07-002).

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