Transportation Air Quality Conformity Report for the Houston-Brazoria-Galveston Region

For 2045 Regional Transportation Plan Update and 2023-2026 Transportation Improvement Program

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Preface

What is the Houston-Galveston Area Council?

The Houston-Galveston Area Council (H-GAC) is the designated Metropolitan Planning Organization (MPO) for the 8-county Houston-Galveston-Brazoria Transportation Management Area (TMA). This area of more than six million people includes the eight counties of Brazoria, Chambers, Fort Bend, Galveston, Harris, Liberty, Montgomery, and Waller Counties and includes 134 cities

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List of Transportation Policy Council and Technical Advisory Committee Members

https://www.h-gac.com/transportation-policy-council/members
https://www.h-gac.com/transportation-advisory-committee/membership-listing

Glossary of Abbreviations

The Glossary of Abbreviations are linked at the following location:

https://www.h-gac.com/transportation-conformity/list-of-acronyms

Document Format

Each chapter of this report represents a distinct conformity step or milestone conducted for the analysis. The following information will be included to support the conformity findings:

- Executive Summary Providing an Overview of the Conformity Analysis and Findings
- Conformity Analysis Specific Requirements, Procedures, and Results
- Local Conformity Determination (MPO Policy Committee Resolution)
- Federal Conformity Determination (Federal Highway Administration & Federal Transit Administration joint U.S. Department of Transportation Memorandum of Review), when available
- Supplemental Information
- Appendix Information

Electronic Submittal

Conformity analysis documentation typically requires a significant amount of information to be submitted through an interagency consultation process. All items of this analysis are provided in electronic format. The electronic structure is organized consistent to this document's Table of Contents by chapter, section, and appendix for efficient reviewing. All supporting materials are provided in electronic format.

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EXECUTIVE SUMMARY

Milestones and Background

On November 4, 2022, the Federal Highway Administration (FHWA) and the Federal Transit Administration (FTA) certified that the Houston-Galveston-Brazoria (HGB) region's amended *2045 Regional Transportation Plan (RTP)* and the amended *2021-2024 Transportation Improvement Program (TIP)* met all the requirements for a joint conformity determination to the Air Quality State Implementation Plan (SIP) for the HGB ozone nonattainment area.

This new conformity determination is being prepared to support the 2045 RTP Update and the amendments to the 2023-2026 TIP. Although the HGB region has been reclassified on November 7, 2022 as "moderate" and "severe" for the 2015[1] and 2008[2] 8-hr ozone standards, with attainment years 2023 and 2026 respectively, the state has not yet submitted new emission budgets to the Environmental Protection Agency (EPA) for consideration. Consequently, this conformity will demonstrate compliance to the latest EPA-approved emission budgets based on the revision to the air quality SIP for the 2008 8-hr Ozone Standard due to the reclassification from moderate to serious with attainment year 2020. The Reasonable Further Progress (RFP) SIP budget was found adequate by the EPA with an effective approval date of June 9, 2021.

In accordance with 23 CFR Part 450 all projects are constrained by the financial resources estimated to be reasonably available within the RTP timeframe. A complete listing of the projects in the RTP and TIP that affect this conformity analysis will be included in Appendix 3 of the conformity report.

Conformity Requirements

The Clean Air Act Amendments of 1990 (CAAA) require transportation plans, programs, and projects in nonattainment and maintenance areas, funded or approved by the FHWA or the FTA, to conform to the motor vehicle emission budgets (MVEBs) established in the SIP. This ensures that transportation plans, programs, and projects do not produce new air quality violations, worsen existing violations, or delay timely attainment of the National Ambient Air Quality Standards (NAAQS). Conformity analysis requirements include:

- Use the latest planning assumptions
- Analysis based on the latest emission estimation model available

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1. https://www.govinfo.gov/content/pkg/FR-2022-10-07/pdf/2022-20460.pdf

2. https://www.govinfo.gov/content/pkg/FR-2022-10-07/pdf/2022-20458.pdf

- Interagency consultation, and a public involvement process, must be conducted during the analysis
- Timely implementation of Transportation Control Measures (TCMs)
- An RTP and TIP that are consistent with the MVEBs established in the applicable SIP (if there is an adequate or approved SIP budget), and
- Inclusion of all regionally significant projects expected in the nonattainment and maintenance area in the RTP and TIP

Regional Inventory

This conformity analysis was developed using air quality regional inventories of the HGB nonattainment area. It accounts for average ozone season (summer) weekday emissions resulting from the nonattainment area's transportation plans, including all regionally significant projects and the effects of emission control programs, such as the inspection and maintenance programs.

Motor Vehicle Emission Budgets

The 2020 budgets established in the HGB RFP SIP for the serious classification for the 2008 8-hr ozone standard are as follows:

HGB RFP 2020 MVEBs Serious classification for 2008 8-hr ozone standard

RFP Demonstration Budgets (t/d)		
Year	***NOx***	***VOC***
2020	87.69	57.70

Source: HGB serious RFP SIP, TCEQ

Emissions Tests

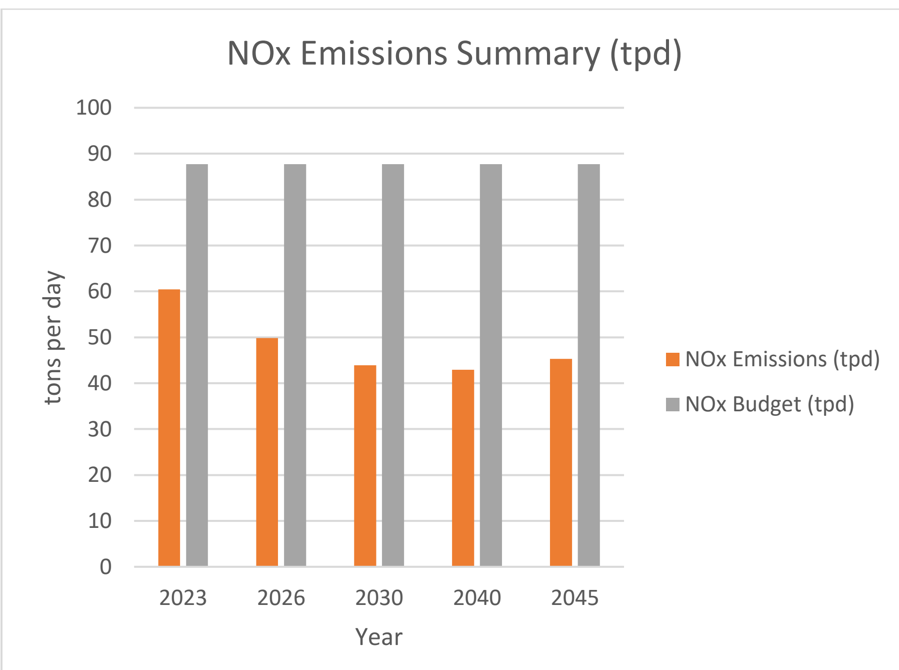
As specified by the Code of Federal Regulations (40 CFR 93.109[c], as amended by 62 FR 43801, Aug. 15, 1997) all ozone nonattainment areas designated moderate and above must pass a MVEB test if an approved SIP budget exists. At the time of this conformity determination, the HGB region is classified as "severe" for the 2008 8-hr ozone standard with an attainment date of July 20, 2027, with a 2026 attainment year and "moderate" for the 2015 8-hr ozone standard, with an attainment date of August 3, 2024, with a 2023 attainment year. Since the state has not yet submitted emission budgets for these classifications, this conformity will demonstrate compliance to the latest EPA-approved emission budgets based on the revision to the air quality SIP for the 2008 8-hr ozone standard due to the reclassification from moderate to serious with attainment year 2020. The RFP SIP budget was found adequate by the EPA with an effective approval date of June 9, 2021.

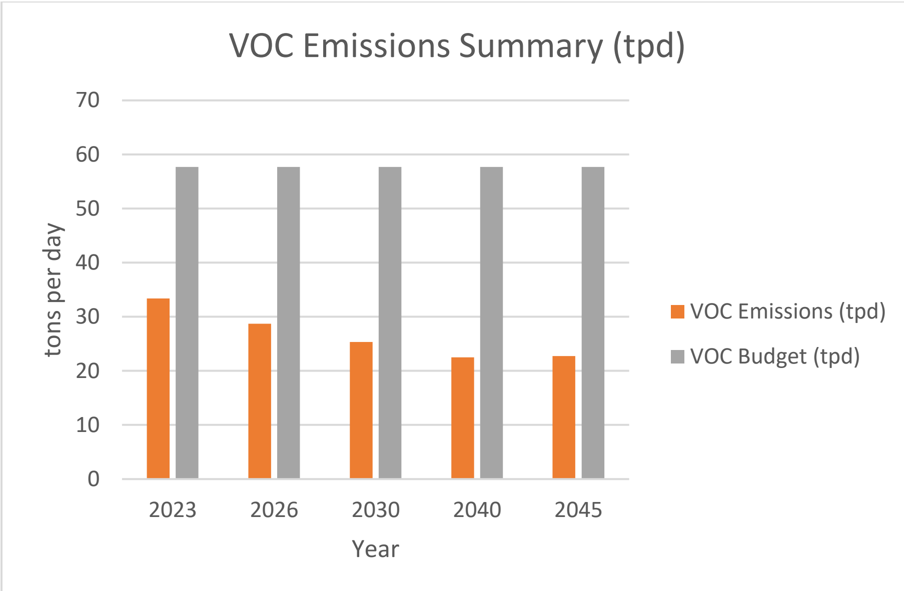
In this case, the budget test must be satisfied using the MVEBs established in the RFP SIP mentioned above. Specifically, this test is satisfied when ozone precursor (VOC and NOx) average summer weekday emissions for each analysis year are less than or equal to the MVEBs established in the SIP. For the test, the regional emission analysis should be performed for any years selected according to the conformity rule. The table and graphs below show the results of this conformity analysis.

Conformity Analysis Results versus HGB RFP MVEBs for serious classification

Year	NOx Emissions (tpd)*	NOx Budget (tpd)	VOC Emissions (tpd)	VOC Budget (tpd)	VMT
2023	60.46	87.69	34.49	57.70	207,127,974
2026	49.81	87.69	29.66	57.70	218,020,232
2030	43.91	87.69	26.03	57.70	237,879,429
2040	42.91	87.69	23.07	57.70	279,828,518
2045	45.27	87.69	23.27	57.70	298,902,646

Note: emissions represent the average summer weekday
*tpd is tons per day





Note: emissions represent the average summer weekday

The results of this conformity determination demonstrate that the *2045 RTP Update and Amendments to the 2023-2026 TIP* for the HGB TMA meet the requirements of the air quality SIPs for the HGB ozone nonattainment area and are in accordance with the Clean Air Act (42 U.S.C. 7504, 7506 (c) and (d)), as amended on November 15, 1990, and the final conformity rule (40 CFR Parts 51 and 93)**.**

Background Information on Conformity

More information on what conformity is and the regulations that apply to it can be found at: https://www.fhwa.dot.gov/environment/air_quality/conformity/index.cfm

This conformity determination involved a pre-analysis review discussion with the review agencies (Chapter 8) and a public comment period (Chapter 9).

Chapter 1: INTRODUCTION

1.1 Reasons for Conformity Determination

On November 4, 2022, the Federal Highway Administration (FHWA) and the Federal Transit Administration (FTA) certified that the amendments to the Houston-Galveston-Brazoria (HGB) region's *2045 Regional Transportation Plan (RTP)* and the *2021-2024 Transportation Improvement Program (TIP)* met all the requirements for a joint conformity determination to the Air Quality State Implementation Plan (SIP) for the HGB ozone nonattainment area.

This new conformity determination is being prepared to support the 2045 RTP Update and amendments to the 2023-2026. The HGB region is in non-attainment for the 2008 and 2015 8-hr ozone standard. The region has been classified as "moderate" for the 2015 8-hr ozone standard and as "severe" for the 2008 8-hr ozone standard with attainment years 2023 and 2026, respectively.

Due to the non-attainment designation for the 2008 and 2015 8-hr ozone standards, the emissions from the transportation plan and transportation improvement program must show conformity with the latest approved motor vehicle emission budgets (MVEBs) coming from the latest revisions to the air quality state implementation plan.

This conformity will demonstrate compliance to both the 2008 and 2015 ozone standards using the latest approved MVEBs for the 2008 8-hr ozone standard due to the reclassification from "moderate" to "serious" with attainment year 2020. The Reasonable Further Progress (RFP) SIP budget was found adequate by the Environmental Protection Agency (EPA) with an effective approval date of June 9, 2021.[1]

In accordance with 23 CFR Part 450 all projects are constrained by the financial resources estimated to be reasonably available within the RTP timeframe. A complete listing of the projects in the RTP and TIP that affect this conformity analysis will be included in Appendix 3 of the conformity report.

1.2 Timeline

- Kick-off meeting with conformity partners – TAC/TPC announcement to start Conformity December 7, 2022
- Model Network review (H-GAC/TxDOT/METRO) – January 2023
  Deadline for pre-approval of networks: 2 weeks later (Final Project listing)
- Pre-Analysis Consensus document review – January 2023
  Deadline for approval of data: 2 weeks later

[1] https://www.govinfo.gov/app/details/FR-2021-05-10/2021-09626

- Travel Demand Model Runs – January 2023
- MOVES Model Runs February 2023
- TAC/TPC Conformity Preview for update to the RTP and TIP – March 2023
- Public Comment – March 2023
- Public Meeting – March 2023
- Public Comment Responses – March/April 2023
- TAC Recommends RTP and TIP with Conformity – April 2023
- TPC Authorizes Initial Adoption of RTP and TIP with Conformity Pending Final Conformity Determination by U.S. Department of Transportation – April 2023
- Request Partner Review/Approval – End of April 2023 – Deadline for approval of this conformity is 8/2/2023. Concludes the four-year cycle of the transportation plan. If no determination is made by 8/2/2023, a one-year conformity lapse grace period will start.

Chapter 2: AIR QUALITY CONFORMITY

2.1 Air Pollution

Air pollution is contamination of the environment by any chemical, physical, or biological agent that modifies the natural characteristics of the atmosphere. Household combustion devices, motor vehicles, industrial facilities, and forest fires are common sources of air pollution.

In response to the Clean Air Act, EPA to set National Ambient Air Quality Standards (NAAQS) for six common air pollutants (also called “criteria pollutants”), that include: ground level ozone, particulate matter, carbon monoxide, lead, sulfur dioxide, and nitrogen dioxide. These standards primarily help to protect the health of sensitive populations as well as provide public welfare protection, including protection against decreased visibility and damage to animals, crops, vegetation, and buildings.

2.1.1 Ground Level Ozone

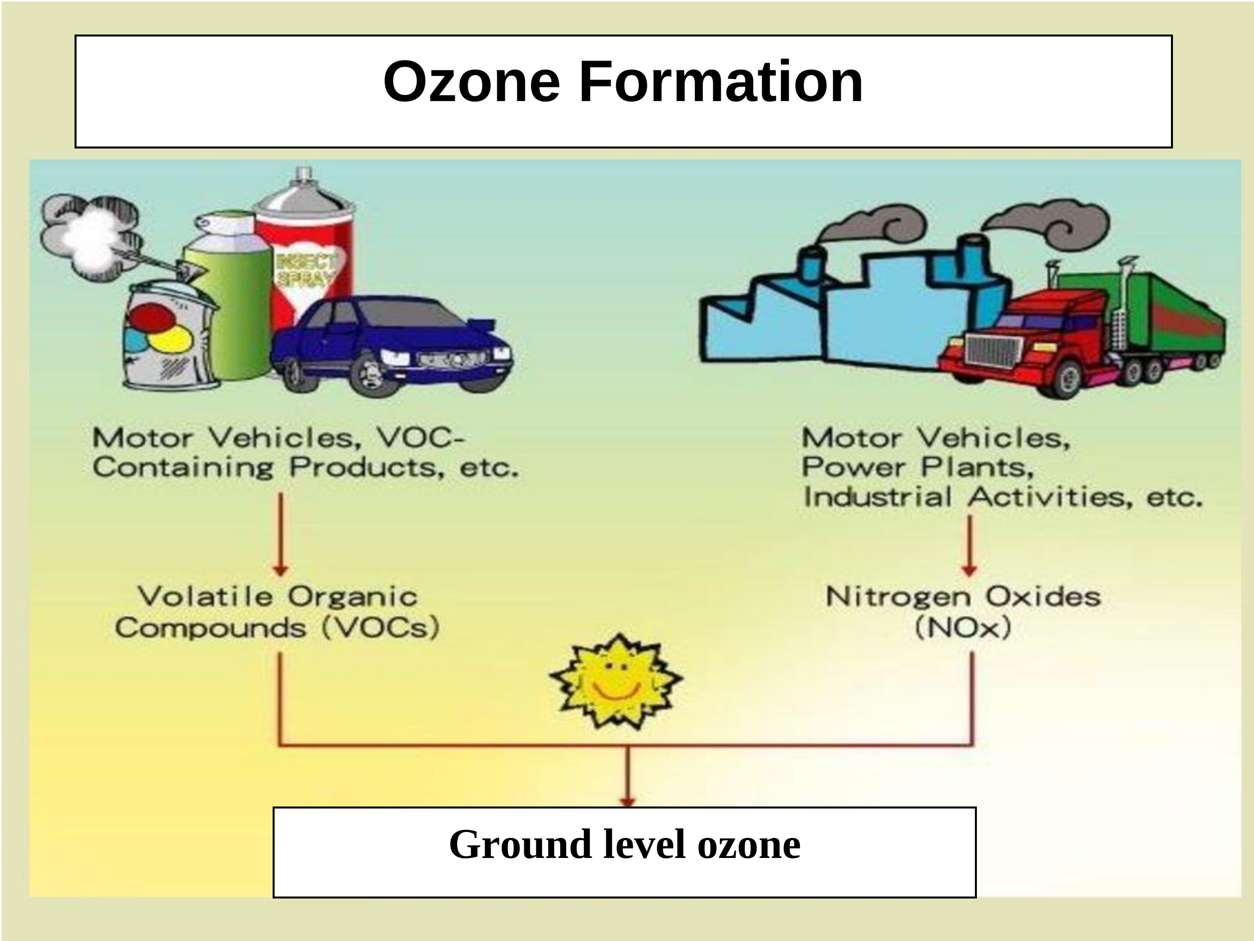
Ozone can be “good” or “bad” for health and the environment depending on where it’s found in the atmosphere. Stratospheric ozone is “good” because it protects living things from ultraviolet radiation from the sun. However, ground-level ozone, is “bad” because it can trigger a variety of health problems, particularly for children, the elderly, and people of all ages who have lung diseases such as asthma.

Tropospheric, or ground level ozone, is not emitted directly into the air, but is created by chemical reactions between oxides of nitrogen (NOx) and volatile organic compounds (VOC). The sources of NOx pollution are automobiles, trucks, and various non-road vehicles (e.g., construction equipment, boats, planes, etc.) as well as industrial sources such as power plants, industrial boilers, cement kilns, and turbines. The sources of VOCs pollution are the same as NOx and in addition solvents, cleaning products, aerosol sprays, and stored fuels.

Tropospheric ozone is formed when NOx and VOCs chemically react in the presence of heat and sunlight.

Ozone is most likely to reach unhealthy levels on hot sunny days in urban environments which is called the “ozone season”. Ozone can also be transported long distances by wind, so even rural areas can experience high ozone levels.

The figure below shows an example of ozone formation.



Source: EPA

2.2 Background on the Houston-Galveston-Brazoria Ozone Nonattainment Area

2.2.1 1-Hour Ozone NAAQS

In 1990, the EPA designated the 8-county HGB area, consisting of Brazoria, Chambers, Fort Bend, Galveston, Harris, Liberty, Montgomery, and Waller Counties, as nonattainment for the 1-hour ozone NAAQS with a severe-17 classification in accordance with the 1990 Federal Clean Air Act (FCAA) Amendments (56 FR 56694). The HGB area was given an attainment date of November 15, 2007. This standard set a maximum limit concentration of 125 parts per billion (ppb). Under the 1-hour ozone NAAQS, no air quality monitoring site was allowed to have more than three exceedances of the set concentration limit over a consecutive three-year period.

In 1997, the 1-hour ozone NAAQS was replaced by the 8-hour ozone NAAQS. The EPA revoked the 1-hour ozone NAAQS in June 2005, but states were required to continue to meet the 1-hour ozone anti-backsliding requirements in 40 Code of Federal Regulations

(CFR) §51.905(a). The HGB area failed to attain the revoked 1-hour ozone standard by the November 15, 2007 attainment date, and the EPA published a failure-to-attain determination on June 19, 2012 based on air quality monitoring data for 2005 through 2007 (77 FR 36400). The anti-backsliding requirements that apply to the HGB severe 1-hour ozone nonattainment area are: contingency measures, nonattainment new source review (NSR) permitting requirements for severe nonattainment areas; and a penalty fee provision.

The HGB area began monitoring attainment of the 1-hour ozone NAAQS in 2013. On May 30, 2014, the EPA concurred that the data met all the quality requirements, and that the HGB area met the one-hour ozone NAAQS. As of today, the region continues to remain in attainment.

2.2.2 8-Hour Ozone NAAQS

2.2.2.1 The 1997 8-hour ozone NAAQS

On July 18, 1997, the EPA revised the NAAQS for ground-level ozone (62 FR 38856). The EPA phased out and replaced the previous one-hour ozone NAAQS with an 8-hour NAAQS due to considerations on human health for long-term exposure to ozone. The 1997 8-hour standard is set at 0.08 parts per million (ppm) based on the three-year average of the annual fourth-highest daily maximum 8-hour average ozone concentrations measured at each monitor within an area. A design value of 0.084 ppm, or 84 ppb, would round down and meet the NAAQS while a design value of 0.085 ppm, or 85 ppb, would round up and exceed the NAAQS.

Effective June 15, 2004, the HGB area, consisting of Brazoria, Chambers, Fort Bend, Galveston, Harris, Liberty, Montgomery, and Waller Counties, was designated nonattainment for the 1997 8-hour ozone NAAQS. The HGB area was classified moderate nonattainment for the standard, with an attainment date of June 15, 2010. However, due to difficulties showing attainment for the new air quality state implementation plan, on June 15, 2007, the state requested that the HGB area be reclassified from a moderate to a severe nonattainment area for the 1997 8-hour ozone NAAQS. On October 1, 2008, the EPA approved Texas' request to reclassify the HGB 1997 8-hour ozone nonattainment area from moderate to severe with a new attainment date of June 15, 2019.

The HGB area demonstrated attainment of the 1997 8-hour ozone NAAQS based on 2012 through 2014 monitoring data. The EPA published a final determination of attainment for the 1997 8-hour ozone NAAQS for the HGB area on December 30, 2015.

2.2.2.2 The 2008 8-hour ozone NAAQS

On March 27, 2008, the EPA lowered the primary and secondary 8-hour ozone NAAQS to 0.075 ppm (73 FR 16436). This standard became effective on May 27, 2008.

Attainment of this standard is achieved when an area's design value does not exceed 75 ppb. On May 21, 2012, the HGB 8-county area, consisting of Brazoria, Chambers, Fort Bend, Galveston, Harris, Liberty, Montgomery, and Waller Counties, was designated nonattainment and classified as marginal under the 2008 8-hour ozone NAAQS, with attainment date December 31, 2015.

On December 23, 2014, the D.C. Circuit Court ruled on a lawsuit filed by the Natural Resources Defense Council, which resulted in vacatur of the EPA's December 31, 2015 attainment date for the 2008 8-hour ozone NAAQS. As part of the EPA's final 2008 8-hour ozone standard SIP requirements rule, the EPA modified 40 CFR §51.1103 consistent with the D.C. Circuit Court decision to establish attainment dates that run from the effective date of designation, i.e., July 20, 2012, rather than the end of the 2012 calendar year. As a result, the attainment date for the HGB marginal nonattainment area changed from December 31, 2015 to July 20, 2015. In addition, because the attainment year ozone season is the ozone season immediately preceding a nonattainment area's attainment date, the attainment year for the HGB marginal nonattainment area changed from 2015 to 2014.

The HGB area did not attain the 2008 8-hour ozone standard in 2014 but qualified for a one-year attainment date extension in accordance with FCAA, §181(a)(5). On May 4, 2016, the EPA published final approval of the one-year attainment date extension for the HGB 2008 8-hour ozone marginal nonattainment area to July 20, 2016, with a 2015 attainment year. However, the HGB area did not reach attainment in 2015, and EPA re-classified the area to "moderate" on December 14, 2016. The attainment date for moderate classification was July 20, 2018, with an attainment year of 2017. The EPA set a January 1, 2017, deadline for the state to submit an attainment demonstration (AD) that addressed the 2008 8-hour ozone NAAQS moderate nonattainment area requirements, including RFP SIP.

Based on monitoring data from 2015, 2016, and 2017, the HGB area did not attain the 2008 8-hour ozone NAAQS in 2017 and did not qualify for a one-year attainment date extension. Therefore, on August 23, 2019, the EPA published the final notice reclassifying the HGB nonattainment area from moderate to serious for the 2008 8-hour ozone NAAQS. As indicated in the EPA's 2008 8-hour ozone standard SIP requirements rule, the attainment date for a serious classification was July 20, 2021, with a 2020 attainment year. The EPA set an August 3, 2020 deadline for states to submit AD and RFP SIP revisions to address the 2008 8-hour ozone standard serious nonattainment area requirements.

The HGB region did not attain the 2008 8-hour standard and was reclassified as "severe" on November 7, 2022, with attainment year 2026.

2.2.2.3 The 2015 8-hour Ozone NAAQS

On October 26, 2015, the EPA published the final rule revising the 8-hour Ozone NAAQS to 70 ppb (80 FR 65281). This standard became effective on December 28, 2015. On June 4, 2018, the EPA published a final rule (83 FR 25776) classifying six counties (Brazoria, Chambers, Fort Bend, Galveston, Harris, and Montgomery) as marginal nonattainment for the 2015 8-hour Ozone NAAQS. This rule became effective on August 3, 2018. Under this marginal classification, the region had until August 3, 2021 to reach attainment, with an attainment year of 2020. The region did not attain the 2015 8-hour ozone standard by this date and was re-classified as a “moderate” nonattainment area on November 7, 2022 with an attainment year of 2023.

Although the region continues to be in non-attainment for the current ozone standards, progress has been made towards compliance as a result of the implementation of emission reduction control efforts in state implementation plans and other regional emission reduction efforts. Figure 2.1 below shows the historical design values in relation to the different ozone standards.

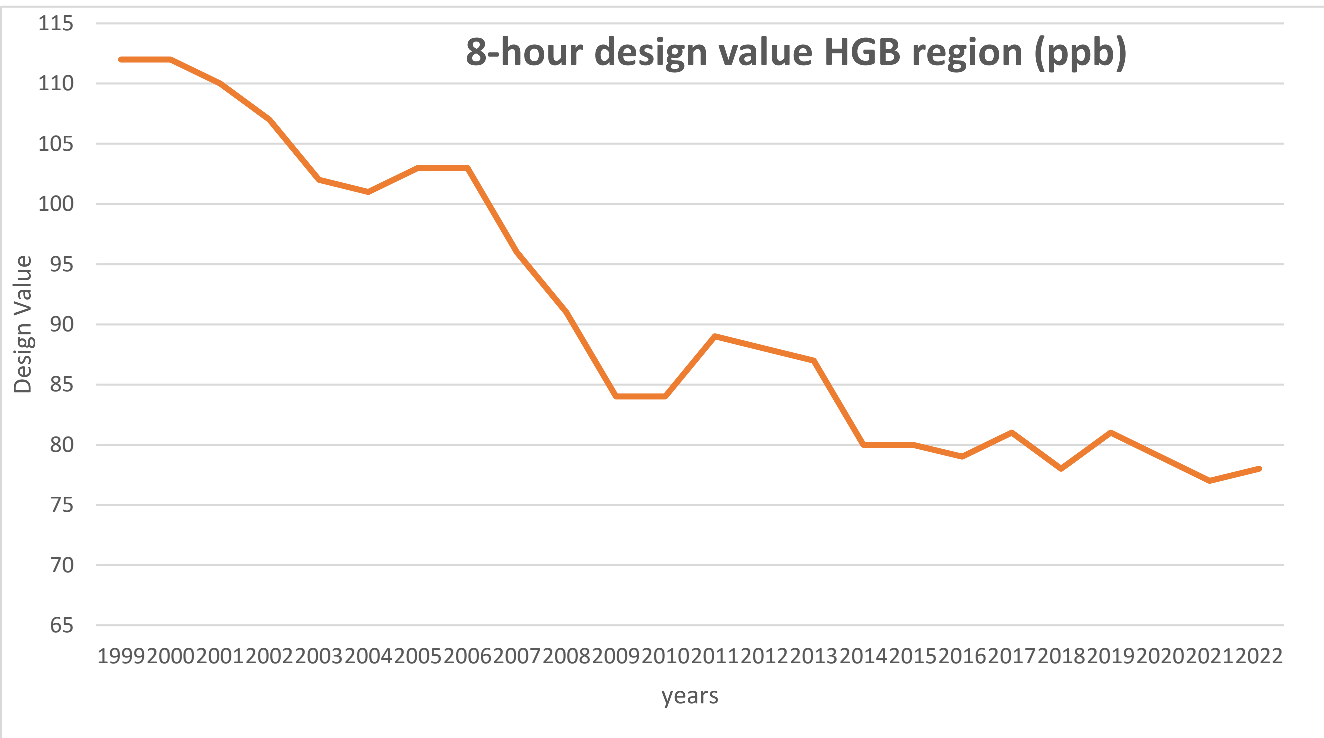


Figure 2.1 8-hour Ozone Design Values (in ppb)

For more information about the history of the non-attainment status of the HGB region please check the website from the Texas Commission on Environmental Quality (TCEQ) at https://www.tceq.texas.gov/airquality/sip/hgb.

2.3 What is Transportation Conformity?

Transportation conformity is the process that links the Air Quality SIP with regional roadway planning, which occurs in the RTP and the TIP. Conformity is demonstrated when projected regional air quality emissions from the transportation plan do not exceed the region's MVEBs stated in the SIP.

While the MPO is ultimately responsible for making sure a conformity determination is made, the conformity process depends on federal, state, and local transportation and air quality agencies working together to meet the transportation conformity requirements.

A new conformity determination must be performed any time a transportation plan is amended in a significant manner, when a region's or state's air quality goals change, and/or every four years when a new transportation plan is created.

2.3.1 Conformity Requirements

The CAAA require transportation plans, programs, and projects in nonattainment and maintenance areas, which are funded or approved by the FHWA or the FTA, to conform to the MVEBs established in the SIP. This ensures that transportation plans, programs, and projects do not produce new air quality violations, worsen existing violations, or delay timely attainment of the NAAQS. Conformity analysis requirements include:

- Use of the latest planning assumptions
- Analysis based on the latest emission estimation model available
- Interagency consultation, as well as a public involvement process, must be conducted during the analysis
- Timely implementation of Transportation Control Measures (TCMs)
- An RTP and TIP that are consistent with the MVEBs established in the applicable SIP (if there is an adequate or approved SIP budget)
- Include all regionally significant projects expected in the nonattainment and maintenance area in the RTP and TIP

Please see next section for the list of applicable regulations for conformity.

2.3.2 Checklist

Table 2.1: Conformity Checklist

INFORMATION REQUIRED FOR TRANSPORTATION CONFORMITY REVIEW			
ITEM	**REGULATION REFERENCE**	**FORMAT**	**REPORT LOCATION**
Documents			
2045 Regional Transportation Plan Update (RTP)	40 CFR 93 Subpart A	Independent Self-Supporting Document	https://engage.h-gac.com/2045rtpupdate
2023-2026 Transportation Improvement Program (TIP)	40 CFR 93 Subpart A	Independent Self-Supporting Document	2023-2026 Transportation Improvement Program | Houston-Galveston Area Council (H-GAC)
Conformity document for the MTP and TIP	40 CFR 93 Subpart A	Independent Self-Supporting Document	This document serves as the conformity document.
Emission Model			
Guidance Supporting MOVES Input Development (SIP Consistency, EPA's Information Sheets, etc.)		Contained in conformity document. EPA information in appendix	Conformity Document Chapter 6. Appendix 6.
Description of Version of MOVES Model Being Used	40 CFR 93.111	Contained in conformity document and appendix	Conformity Document Chapter 6. Appendix 6.
MOVES Input and Output Files		Contained in Appendix (Electronic file - ASCII or txt file format)	Appendix 9 Appendix 11
Additional SEE Input Files		Contained in Appendix	Appendix 7
MOVES Emission Factors		Contained in Appendix (Electronic file - ASCII or txt file format)	Appendix 11
MOVES External Reference Files		Contained in Appendix (Electronic file - ASCII or txt file format)	Appendix 9
Mobile Source Emissions Reduction Strategies (MoSERS)			
MoSERS Methodology and Calculation Descriptions		N/A	N/A
MoSERS Project Listing		N/A	N/A

Travel Demand Model			
Highway Performance Monitoring System Adjustment(s), Factors, Approach	40 CFR 93.122(b)(3)	Contained in conformity document and appendix	Conformity document Chapter 4 and Appendix 4
Description of Travel Demand Model Validation, Including Validation Year	40 CFR 93.106(a)(1)(ii)	Contained in conformity document and appendix	Conformity document Chapter 4 and Appendix 4
Vehicle Miles of Travel (VMT) (August Midweek 24- hour by Roadway Type)		Contained in conformity document	Conformity document Chapter 4
Average Loaded Speeds (August Midweek 24- hour by Roadway Type)		Contained in conformity document	Conformity document Chapter 4

INFORMATION REQUIRED FOR TRANSPORTATION CONFORMITY REVIEW

ITEM	REGULATION REFERENCE	FORMAT	REPORT LOCATION
Travel Demand Model (continued)			
Centerline Mile Summaries for Each Analysis Year		Contained in conformity document	Conformity document Chapter 4
Definition of Regionally Significant Roadway System		Contained in conformity document	Conformity document Chapter 3
Network Link Listing for Each Analysis Year		Contained in appendix	Appendix 5
Files Containing Hourly Distribution By County, Roadway Type, and Vehicle Type for: - Vehicle Miles of Travel - Vehicle Hours - Average Operational Speed - NO_X Emissions - VOC Emissions		Contained in appendix (Electronic Files in Tab Delimited Summary Tables)	Appendix 16 and Appendix 18
SIP Requirements			
TCMs in SIP Including Emission Reductions, Methodologies, Implementation Dates, etc.		Contained in conformity document and appendix	Conformity document Chapter 7 and Appendix 12
Timely Implementation of TCMs (progress)	40 CFR 93.113	Contained In conformity document	Conformity document Chapter 7
Project Listings			
Congestion Mitigation and Air Quality Projects Containing: Emission Benefits, Methodologies, and Implementation Dates		Identified in RTP, TIP and appendix	See RTP and TIP links above and Appendix 3
Roadway System (Capacity Staging)		Identified in RTP, TIP and appendix	See RTP and TIP links above and Appendix 3

List of Non-Federal Projects	In response to March 2, 1999, court ruling	Identified in RTP, TIP and appendix	See RTP and TIP links above and Appendix 3
INFORMATION REQUIRED FOR TRANSPORTATION CONFORMITY REVIEW			
ITEM	**REGULATION REFERENCE**	**FORMAT**	**REPORT LOCATION**
Project Listings (continued)			
List of Exempt Projects	40 CFR 93.105(c) 40 CFR 93.126 40 CFR 93.127[1] 40 CFR 93.128	Identified in RTP, TIP and appendix	See RTP and TIP links above and Appendix 3
Evidence of Fiscal Constraint	40 CFR 93.108	Identified in RTP, TIP	See RTP and TIP links above
Evidence of MTP Specifically Describing the Transportation System Envisioned for Each Analysis Year	40 CFR 93.106(a)	Identified in RTP	See RTP link above
Public, State, and Federal Involvement			
Conformity Pre-Consensus Plan		Contained in appendix	Appendix 17
Documentation of interagency consultation dialogue (conference calls, etc.)	40 CFR 93.105(b)	Contained In conformity document and appendix	Conformity document Chapter 8 and Appendix 14
Questions and comments raised through interagency consultation process and responses	40 CFR 93.105(b)(2)	Contained in appendix	Appendix 14
Evidence of Public Participation and Response to Comments	40 CFR 93.105(7)(e)	Contained In conformity document and appendix	Conformity document Chapter 9 and Appendix 15
General			
Glossary of Abbreviations		Website	https://www.h-gac.com/transportation-conformity/list-of-acronyms
Endorsements and/or Resolutions		Contained in appendix	Appendix 1
Memorandum of Agreements		N/A	N/A
Applicable Federal Register Notices and Related Documents		Contained in conformity document and appendix	Throughout conformity document and appendices

DISCLAIMER: This checklist is intended solely as an informal guideline to be used in preparing and reviewing transportation conformity documentation. It is not intended to replace or supersede the Transportation Conformity Regulations 40 CFR Parts 51 and 93, Statewide and Metropolitan Planning Regulations 23 CFR Part 450, or any EPA, FHWA, and FTA guidance pertaining to Transportation Conformity or Statewide and Metropolitan Plan

[1] Projects listed in 40 CFR 93.127 are exempt from regional emissions analysis, but not localized emissions (hot-spot) analysis.

2.3.3 Emissions Analysis

A regional emissions analysis is the key analytic component of the transportation conformity process. It is conducted to demonstrate that regional emissions from mobile sources do not exceed the established MVEBs from air quality SIPs, cause or contribute to violations of the NAAQS, and ensure transportation activities are consistent with air quality goals identified in the SIP.

2.3.4 Regional Inventory

The conformity analysis develops air quality regional inventories of the HGB nonattainment area. It accounts for average summer weekday emissions resulting from the nonattainment area's transportation plans, including all regionally significant projects and the effects of emission control programs, such as the inspection and maintenance programs.

2.3.5 Emissions Tests

The HGB region is in non-attainment for the 2008 and 2015 8-hour Ozone Standards and therefore the Air Quality SIP must regulate the Ozone precursors, which are NOx and VOCs. As specified by the Code of Federal Regulations (40 CFR 93.109[c], as amended by 62 FR 43780, Aug. 15, 1997) all ozone nonattainment areas designated moderate and above must pass a NOx and VOCs MVEBs test if an approved SIP budget exists.

This conformity determination will be using the latest EPA approved MVEBs from the RFP SIP for the serious classification, which was found adequate by the EPA on May 10, 2021, with June 9, 2021 as effective date. This SIP has the year 2020 as the attainment year.

Specifically, the budget test is satisfied when ozone precursor (VOCs and NOx) average summer weekday emissions for each analysis year are less than or equal to the MVEBs established in the SIP. For the test, the regional emission analysis should be performed for any years selected according to the conformity rule.

The 2020 budgets established in the HGB serious RFP SIP are as follows:

Table 2.2: HGB Serious RFP 2020 MVEBs (2008 8-hour ozone standard)

RFP Demonstration Budgets (t/d)		
Year	***NOx***	***VOC***
2020	87.69	57.70

Source: RFP SIP, TCEQ

These MVEBs represent the maximum allowable amount of emissions that may be produced by on-road sources due to the implementation of the RTP and TIP. These budgets are developed based on the average ozone season (summer) weekday emission inventories and the analysis conducted for the development of the RFP SIP and include emission reduction benefits from federal and state control programs.

2.3.6 Analysis Years

For the emission budget test, according to the conformity rule, 40 CFR 93.106, the regional emission analysis years should be selected according to the following:

- any years within the timeframe of the transportation plan, provided they are not more than ten years apart,
- any year with an emission analysis budget,
- the attainment year, and
- the transportation plan horizon year.

Table 2.3 shows the conformity analysis years and describes their corresponding requirements for calculations.

Table 2.3: Conformity Analysis Years

Requirement	Years
Attainment Year	2023 and 2026[1]
Motor Vehicle Emissions Budget Years	-------
First Analysis Year	2023
Intermediate Analysis Years	2030, 2040
Last Year of RTP	2045

[1]Attainment year 2023 for the 2015 8-hour Ozone Standard and attainment year 2026 for the 2008 8-hour Ozone Standard

Chapter 3: REGIONAL TRANSPORTATION PLAN AND TRANSPORTATION IMPROVEMENT PROGRAM

3.1 Regional Transportation Plan

3.1.1 Overview

H-GAC's Transportation Policy Council (TPC) considered the 2045 Regional Transportation Plan (RTP) update and amendments to the Fiscal Year 2023-2026 Transportation Improvement Program (TIP) for approval on April 28, 2023.

The 2045 RTP update covers a planning period of 2023 through 2045 and contains a list of projects fiscally constrained by estimates of reasonably available revenues. The complete 2045 RTP is available online at h-gac.com/rtp.com.

The 2045 RTP update reflects the priorities for transportation investments within the H-GAC TMA. A complete listing of fiscally constrained projects, as proposed under this conformity determination, is provided under Appendix 3. This listing denotes projects which are regionally significant or otherwise subject to transportation conformity and those projects which are exempt from transportation conformity, exempt from regional emissions analysis, or have been determined to be not regionally significant.

3.1.2 Submittal Frequency

Consistent with the requirements of Title 23 United States Code (U.S.C.) Section 134, the Regional Transportation Plan (RTP) is required to be updated every four years. Since the HGB area is a non-attainment area for the 2008 and 2015 8-hour Ozone Standard, every amendment or update to the RTP must show conformity to the air quality budgets coming from the latest revisions to the State Air Quality Plan. If more than four years elapse after FHWA's conformity determination for a plan update, a 12-month grace period shall be in force. At the end of this 12-month grace period, the existing conformity determination will lapse.

A conformity determination for a transportation plan must be based on the plan and all amendments. According to 40 CFR 93.104, RTP update or amendments must be demonstrated to conform before amendments are approved by the H-GAC's TPC or accepted by DOT, unless the amendment merely adds or deletes exempt projects listed in 40 CFR 93.126 or 40 CFR 93.127.

3.1.3 Fiscal Constraint

All transportation plans prepared by the MPO are required to be fiscally constrained. Fiscal constraint is demonstrated by a financial plan that outlines reasonably available future revenues to implement the projects listed in the transportation plan.

H-GAC estimated the reasonably available future revenues by projecting transportation related funds contained in the latest adopted budgets from local agencies, relevant TxDOT data, and regional toll revenues at 2% per year till 2045 (2023-2045). The 2045 RTP update estimates $141 billion of revenue to be reasonably available to implement the recommendations. The 2045 RTP update's total expenditure is estimated to be approximately $109 billion.

3.2 Transportation Improvement Program

3.2.1 Overview

H-GAC's TPC approved the Fiscal Year (FY) 2023-2026 initial TIP on May 20, 2022. This TIP covers planning period of fiscal year 2023 through 2026and contains a list of fiscally constrained funding commitments and reasonably available revenues. The initial adopted TIP and subsequent amendments are available at https://www.h-gac.com/transportation-improvement-program.

The initial TIP is consistent with the transportation conformity finding issued by the FHWA, and the FTA on November 4, 2022.

The current FY 2023-2026 TIP will be amended to reflect the changes to fiscally constrained projects. A complete list of projects, as proposed under this conformity determination is provided in Appendix 3. This listing includes projects which are regionally significant or otherwise subject to transportation conformity and those projects which are exempt from transportation conformity, exempt from regional emissions analysis, or have been determined to be not regionally significant.

3.2.2 Submittal Frequency

Every MPO must update the Transportation Improvement Program (TIP) at least once every four years in accordance with 23 CFR 450.326. Within the State of Texas, MPOs work with TxDOT, local public agencies and public transportation providers to update the STIP every 2 years. An MPO's TIP update cycle must be compatible with the Texas STIP development and approval process.

As a designated nonattainment area H-GAC and TxDOT must make a conformity determination on any updated or amended TIP, in accordance with the Clean Air Act requirements and the EPA's transportation conformity regulations (40 CFR 93, subpart A). Conformity determination for a TIP must be based on the TIP and all amendments taken as a whole, and must be demonstrated to conform before the TIP amendments are approved by H-GAC's TPC or is accepted by DOT, unless the amendment merely adds or deletes exempt projects listed in 40 CFR 93.126 or 40 CFR 93.127.

3.2.3 Fiscal Constraint

All TIPs prepared by the MPO are required to be fiscally constrained. This is demonstrated by a financial plan that identifies all the reasonably available future revenues for programming. Chapter 2 of the FY 2023-2026 TIP outlines the financial plan utilized to implement the projects programmed through the FY 2023-2026 TIP.

3.3 Regionally Significant Travel Projects/Programs

Projects determined to be regionally significant, except as specifically exempted under 40 CFR 93.126, 40 CFR 93.127, 40 CFR 93.128 and must come from a conforming RTP and TIP, or be individually found to conform prior to the issuance of federal approvals and other actions. H-GAC has developed the following definition to classify projects as regionally significant for conformity purposes:

Regionally Significant Roadway Projects

Non-exempt[1] projects on regionally significant roadways will be treated as regionally significant projects if they:

a. Provide additional through traffic lanes greater than 1 mile in length.
b. Construct a bypass to a principal arterial/interstate along a new alignment.
c. Add or extend freeway auxiliary/weaving lanes from one interchange to a point beyond the next interchange.
d. Construct a new interchange that provides access from or allows movement between facilities that was not previously possible; and/or
e. Remove an existing interchange and result in the elimination of access from or movement between facilities which previously existed.

Regionally significant roadways are limited to:

1. All freeways, tollways and other highways classified as principal arterial or higher; and
2. Selected highways as identified in Figure 3.1, currently designated as minor arterials that serve significant interregional and intraregional travel and connect rural population centers not already served by a principal arterial or connect with intermodal transportation terminals not already served by a principal arterial.

Regionally Significant Transit Projects

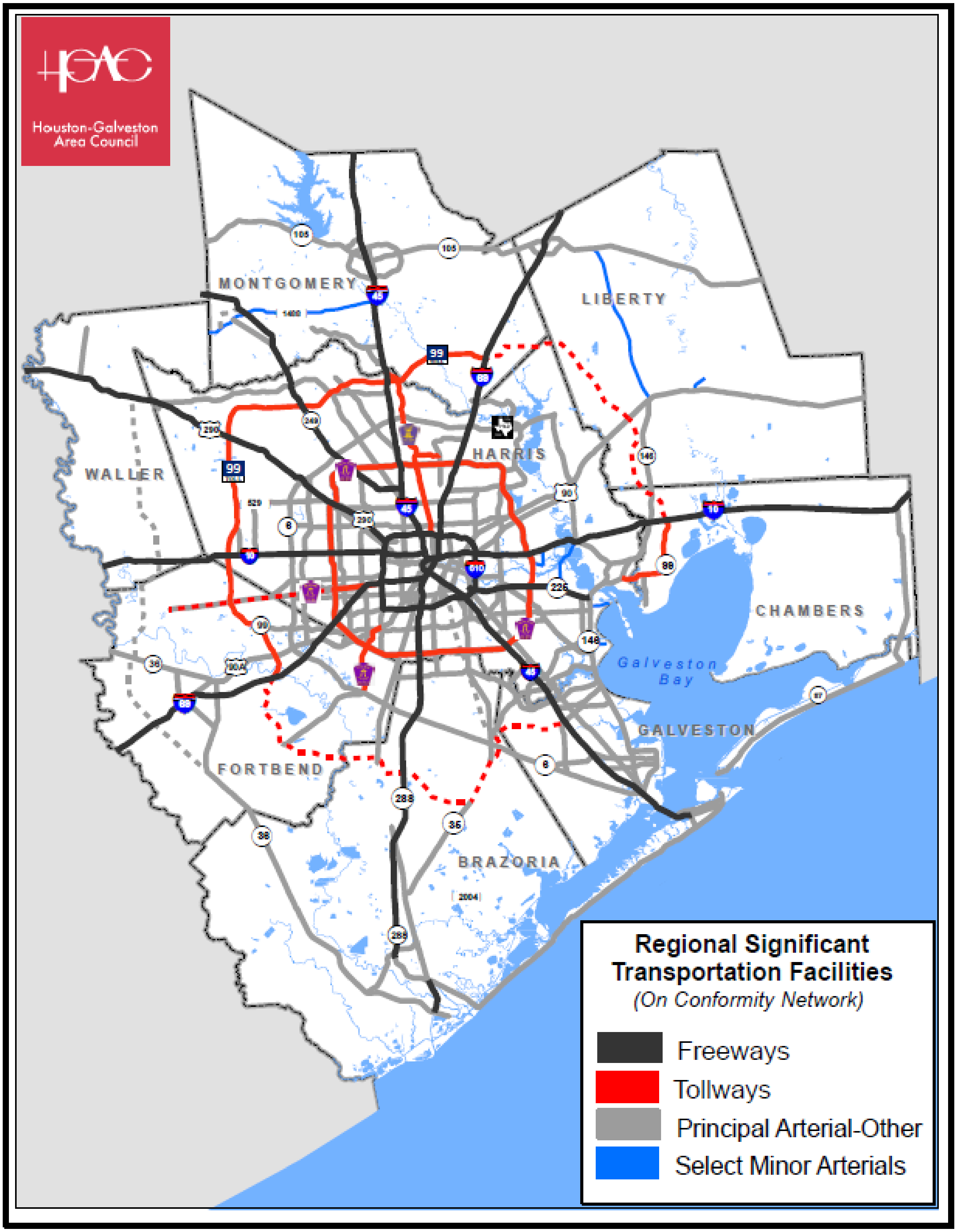
Any transit facility within an exclusive right-of-way ("fixed guideway") that offers an alternative to regional highway travel including light rail, commuter rail, bus rapid transit, and barrier separated High Occupancy Vehicles (HOV) lanes shall be considered regionally significant.

Other Projects

The regional significance of non-exempt projects[1] not addressed in the statements above will be decided on a case-by-case basis through the interagency consultation process. The consultation will occur before the plan is taken to the Transportation Policy Council (TPC) (either plan or TIP revision), and prior to the environmental determination.

[1] Non-exempt projects include all projects that are not identified under 40 CFR 93.126 or 40 CFR 93.127 as exempt or exempt from regional emissions analysis

Figure 3.1: Regionally Significant Transportation Facilities



3.4 Non-Federal Projects/Programs

In accordance with 23 CFR 450.324 the transportation plan must include the design concept and descriptions for all existing and proposed regionally significant transportation projects, regardless of funding source, and must identify all necessary financial resources from public and private sources that are reasonably expected to be available to carry out the plan. Such regionally significant projects are included within the plan's conformity determination.

Non-federal projects funded by sources such as local governments and local transportation authorities, such as signal improvements, intersection improvements, and local roadway widening, may be of insufficient scale or scope to require inclusion within a transportation conformity regional emissions analysis. These "non-regionally significant" projects that do not require any federal project approval actions (e.g., environmental clearance or permit approvals) are not individually listed within the RTP or TIP.

3.5 Exempt Projects/Programs

40 CFR 93.126 identifies several project types exempt from the requirement of a conformity determination. When a conforming plan or TIP is revised by the addition or deletion of an exempt project, a new conformity determination is not required. Some of the exempt projects listed under 40 CFR 93.126 include: continuation of ridesharing and vanpooling promotion activities at current levels, bicycle and pedestrian facilities, railroad/highway crossing, fencing, shoulder improvements, purchasing replacement transit vehicles, and road landscaping. 40 CFR 93.127 identifies project types which are exempt from a regional emissions analysis, but that may require project-level conformity. These include intersection channelization projects, intersection signalization projects at individual intersections, interchange reconfiguration projects, changes in vertical and horizontal alignment, truck size and weight inspection stations, and bus terminals and transfer points. Additionally, 40 CFR 93.128, exempts traffic signal synchronization projects; however, regionally significant traffic signal synchronization projects must be included in subsequent regional emissions analyses.

Chapter 4: ESTIMATION OF VEHICLE ACTIVITY

4.1 Travel Model Overview

The previous 2045 RTP conformity amendment analyses (executed in year 2022) and this conformity analysis (executed in year 2023) utilize the 2016 model validation year and identical model components and parameters. The only changes are the transportation network and future demographic forecast. The transportation network was updated to reflect projects being adjusted from the previous amendments to the RTP 2045.

The model set is a traditional 4-step regional travel demand model with iterative feedback procedures. The four steps are represented in the figure below:

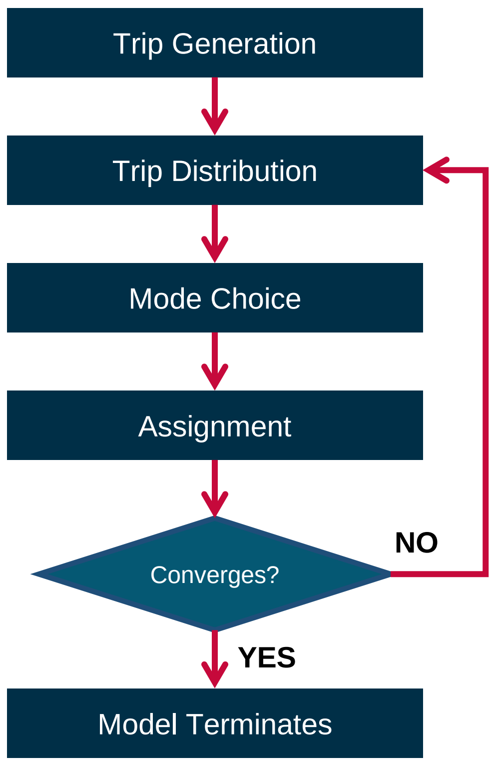


Figure 4.1: Traditional 4-Step Model General Procedure

This model forecasts every trip traveled in the region based on the number of households and employment figures. The trip characteristics forecasted include the number of trips, trip origins / destinations (OD), and travel mode. The model assigns all vehicle trips to the roadway network and produces vehicle miles traveled (VMT) at the link-level. The assigned roadway network with forecasted VMT is then processed by the emissions model for mobile emission analysis, as discussed in Chapter 6.

The model is calibrated using the 2007-2009 household travel survey, the 2010 on-board transit survey, and the 2010-2011 Workplace and Special Generator Survey. The base year of the model is 2016; (hereinafter referred to as the 2016 model). The roadway assignment is validated using the year 2016 annual traffic counts collected by the Texas Department of Transportation.

Brief descriptions of the 2016 model components are provided in section 4.2. Further, details of the 2016 model components and validation results are attached in Appendix 4.

4.2 Multimodal Transportation Analysis Process

4.2.1 Trip Generation Model

Traffic Analysis Zones (TAZ) and Socio-Demographic Inputs

The 8-county Houston MPO metropolitan planning area is formed by Harris, Brazoria, Fort Bend, Waller, Montgomery, Liberty, Chambers, and Galveston counties, and cover an area of about 7,809 square miles.

The 2016 model contains 5,263 traffic analysis zones (TAZs), of which 5,217 are internal zones and are 46 external zones (or stations).

Demographic estimates and forecasts for the TMA are developed in-house by H-GAC staff. H-GAC's 2016 Regional Growth Forecast of population and employment provides the demographic inputs to the travel demand model. The Regional Growth Forecast system produces household, employment, and land use forecasts in annual increments from the year 2016 to the year 2045. For this conformity analysis, the defined base year for the forecast is 2016. The 2016 base year data was assembled from the 2010 U.S. Census, American Community Survey (ACS) data, Texas Workforce Commission, Woods & Poole, and other observed data sources. The Regional Growth Forecast system produces future year socio-demographic forecasts in the following phases:

1. Forecast the total number of people and households in the region
2. Based on the future labor force, forecast the number of jobs.
3. Predict the location, type, and size of residential and non-residential development projects needed to accommodate the expected growth in households and jobs.
4. Allocate the expected growth in households and jobs to different parcels.

The basic geographic unit for the travel demand model is the TAZ. Parcel level forecasts for each parcel within the TAZ are aggregated to define the number of households and level of employment for the TAZ.

The validation of the 2016 base year demographics is documented in Appendix 4. The details and documentation of H-GAC's Regional Growth Forecast[2] can be found on H-GAC's web site https://www.h-gac.com/regional-growth-forecast.

The socio-demographic forecast has not been updated since the 2022 conformity was completed. The 2018 H-GAC Regional Growth Forecast was used for the 2022 conformity and will also be used in this analysis. Table 4.1 summarizes number of households by county (which excludes group quarters such as prisons and dormitories) for the year 2010 and 2016 socio-demographic forecasts.

Table 4.1: County Households for 2010 and 2016

County	Year 2010	Year 2016	Change	% Change
Brazoria	106,589	128,007	21,418	20.09%
Chambers	11,952	13,670	1,718	14.37%
Fort Bend	187,384	258,521	71,137	37.96%
Galveston	108,969	121,800	12,831	11.77%
Harris	1,435,144	1,619,701	184,557	12.86%
Liberty	25,073	29,734	4,661	18.59%
Montgomery	162,530	208,612	46,082	28.35%
Waller	14,040	18,850	4,810	34.26%
Region Total	2,051,692	2,398,895	347,203	16.92%

A comparison of the year 2010 and year 2016 employment for the 8-county region, as presented in Table 4.2, shows that employment increased comparably with population growth, 18.12% percent overall. Harris County gained 272,829 jobs while Montgomery County employment grew 51.76% percent (72,398 jobs). In addition to the household, population, and employment values themselves, the ratio of these variables to each other is frequently used to assess changes to a region's demographic characteristics over time.

Table 4.2: Year 2010 and 2016 County Employment from H-GAC's Regional Growth Forecast

County	Year 2010	Year 2016	Change	% Change
Brazoria	84,422	117,472	33,050	39.15%
Chambers	12,403	17,430	5,027	40.53%
Fort Bend	148,418	214,742	66,324	44.69%
Galveston	95,512	130,118	34,606	36.23%

[2] H-GAC, 2016. "H-GAC's Regional Growth Forecast." *H-GAC*, 2016, Website: https://www.h-gac.com/regional-growth-forecast

Harris	2,236,969	2,509,798	272,829	12.20%
Liberty	14,286	18,045	3,759	26.31%
Montgomery	139,884	212,282	72,398	51.76%
Waller	11,273	20,434	9,161	81.26%
Region Total	2,743,167	3,240,321	497,154	18.12%

Trip Generation

Trip generation is performed with a trip production model and a trip attraction model for each trip purpose. These models use the zonal demographic forecast from the year 2016 release to estimate the total number of trips for each TAZ.

Trip Rates

The trip production model uses cross-classification household trip production rates derived from the 2007-2009 regional household survey. The production rates have three dimensions: household income, household size, and workers per household. This allows for trip demand to be sensitive to differences in the number of workers in a household.

Trip attraction rates were developed based on the 2010/2011 regional workplace survey. Trip attraction rates are stratified by employment category and area type. The area type is determined by geographic location and development density of neighboring TAZs.

Special Generators

Special generators are locations where the number of trip ends cannot be accurately predicted using standard trip rate procedures. Two special generators in the 2016 model are the region's two large commercial airports, Bush Intercontinental and Hobby airports. The site control totals for these airports were developed using data from the 2010/2011 regional special generator survey.

Non-resident trips

Estimates of trip ends for trips made by non-residents for the coastal portions of the region were updated based on year 2016 estimates of tract-level seasonal housing as well as hotel and seasonal housing vacancy rates.

Truck Trips

Truck trip demand for the 2016 model was developed using H-GAC's Cube Cargo-based truck model. The model segments truck demand into cargo truck or service truck demands and estimates both internal and external-local (external-internal) truck movements occurring within the H-GAC region. As opposed to estimating truck demand based on trip rates, H-GAC's truck model estimates demand for cargo-carrying trucks based on demand for and flow of commodities to, from, and through the Houston region.

<u>External travel</u>

External travel demand, both local (internal-external trips or vice versa) and through (external-external trips), was updated based on external volume and vehicle classification counts conducted by H-GAC in 2016. The new volume and classification counts were used to create external-local (external-internal) and through trip ends for auto travel and external-through (external-external) trips for truck travel. External-local (external-internal) truck travel was estimated separately through the Cube Cargo-based truck demand modeling.

4.2.2 Trip Distribution Model

The trip distribution model connects trip ends estimated in the trip generation model, creating origin-destination (OD) TAZ pairs and resulting in OD trip tables. The methodology utilized to produce such tables is the Disaggregated Trip Distribution Model, or Atomistic Model, a gravity-analogy-based model. The Atomistic Model considers the effects of impedance and accessibility of potential zonal destinations in assigning the number of trips produced from one originating TAZ to each destination TAZ.
The trip distribution of all Home-Based Work (HBW) trips use a composite travel time as the measure of zonal impedance, while all other trip purposes use volume-to-capacity results from the Mid-Day (9 am to 3 pm) traffic assignment. The composite travel time used in HBW distribution is a weighted combination of AM peak period traffic assignment results and peak transit travel time. The zonal impedance is iteratively updated over the course of multiple iterations of trip distribution, mode choice, and assignment models of the 4-step procedure.

Friction factors for all internal trip purposes were calibrated so that model-estimated average trip lengths (or trip travel times) by trip purpose were consistent with self-reported average trip length from the 2007-2009 regional household survey.

4.2.3 Mode Choice Model

The Mode Choice model determines the mode of travel for every trip with the consideration of numerous factors. The factors considered include auto operating costs, transit fares, parking cost, and travel time of each available mode between each OD TAZ pair. The outputs of the mode choice model are the number of auto and transit trips between every OD TAZ pair. Note that transit trips are only considered/forecasted if transit service connecting the two OD TAZ pairs is available.

The 2016 mode choice model is a nested logit model. It has two major nests of auto and transit, and there are various modes under each nest, refer to Figure 4.2 below. Toll demand is not estimated in the mode choice model; hence toll was not included in the nested model. Figure 4.2 is the graphical depiction of the nested logit model structure.

The mode choice model was calibrated with year 2010 modal target values developed from the 2007-2009 regional household survey and a 2010 transit on-board survey.

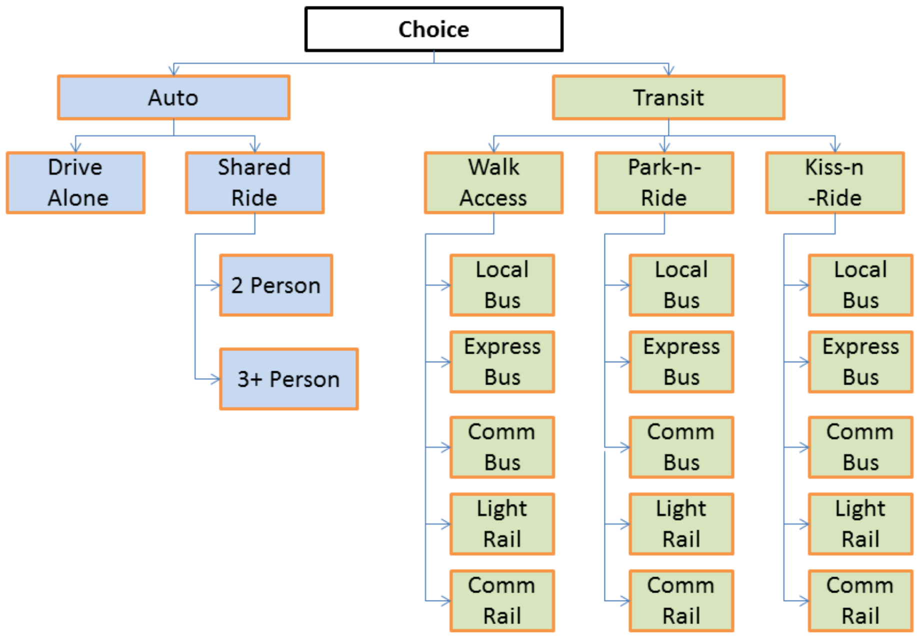


Figure 4.2: Mode Choice Model Structure

4.2.4 Assignment Model

<u>Time-of-Day Model</u>

The time-of-day model distributed the daily auto travel demands into one of the four time-of-day periods. The four time-of-day periods are AM Peak (6 am to 8:59 am), Mid-Day (9 am to 2:59 pm), PM Peak (3 pm to 6:59 pm), and Overnight period (7 pm to 5:59 am).

Using data from the 2007-2009 regional household travel survey, time-of-day (or diurnal) factors for each time-of-day periods were developed. These diurnal factors perform two functions: First, to factor the daily demand to the time period of interest, and second, impart the appropriate directionality of travel for time period of interest. The time-of-day models utilize these diurnal factors to produce the trip table inputs for the Roadway Assignment Model.

<u>Assignment Methodology</u>

The Roadway Assignment Model consists of multi-class, generalized-cost, user equilibrium assignments for each of the four time periods defined above. The travel time is calculated using the assigned route's volume-capacity ratio and distance. The user equilibrium applies an iterative process to achieve a convergent solution in which no travelers can improve their path by shifting routes, otherwise known as user-optimized equilibrium.

The toll demands are estimated through the generalized cost method which makes use of values-of-time that are segmented by trip purpose, income, and mode. Tolls are converted into travel time equivalent according to values-of-time. In this way, toll demands may be responsive not only to the time-of-day, but also to a trip's purpose and occupancy (e.g., Single Occupancy Vehicle or High-Occupancy Vehicle).

The Roadway Assignment Model performs the vehicle assignment for each time-of-day period independently, using the trip tables produced in the Time-of-Day model. The daily demand is the sum of the four time-of-day assignment results.

Iterative Feedback

The 2016 model used two measures of zonal impedance in the distribution of trip ends. A set of assumed zonal impedances were used in trip distribution and mode choice models, and another set of zonal impedances were calculated upon the assigned volumes. These two sets of zonal impedances would be interpreted as the difference between perceived impedance of travelers and the actual impedance on the roads. As travelers perceive zonal impedance based upon their experience travelling on the transportation network, there should be some similarity between the two sets of zonal impedance. The iterative feedback ensures that the zonal impedances used in trip distribution and mode choice model are within acceptable range of difference with impedances calculated from subsequent traffic assignment travel times. These impedance measures were iteratively updated following traffic assignment and fed-back as inputs to the trip distribution models for repetitive applications of the trip distribution, mode choice, and traffic assignment models (see Figure 4.1). This iterative feedback ends when the gap of impedance used in trip distribution models and the impedance calculated from successive assignment results reaches the predefined threshold. Appendix 4 outlines and discusses these convergence criteria.

For HBW trips, a composite measure of AM peak period congestion was fed-back. The composite measure is developed by combining highway travel times based upon speeds from the AM peak period traffic assignment and transit travel time based on peak transit service levels. The technique used to feedback congested travel times to the non-work trip distribution process used speeds from a mid-day period traffic assignment. Both the HBW and non-work feedback used the Method of Successive Average (MSA) technique to calculate values of the traffic volumes to be used to calculate the travel times to be fed-back to trip distribution model.

Table 4.3: Travel Demand Model

Model Factors*	Detail and Methodology
Model Validation Year	2016
Software	Cube Voyager
VMT adjustment - HPMS	H-GAC will adjust the forecasted VMT to TxDOT's HPMS for all roadway facilities. Please see below and Appendix 4
VMT adjustment -Seasonal Correction Factor	Please see Table 4.4
Time Periods Designation	Refer to Section 4.2.5
Counties Covered by Model	Harris, Galveston, Brazoria, Fort Bend, Montgomery, Liberty, Chambers, and Waller.

4.3 Speed Estimation Procedure

The original Houston Speed Model is based on the speed estimation procedures suggested in a report, *Highway Vehicle Speed Estimation Procedures for Use in Emissions Inventories* (a draft report prepared for the U.S. Environmental Protection Agency [EPA] by Cambridge Systematics Inc., September 1991). The original Houston Speed Model is described in the technical memorandum, *Implementation and Calibration of a Speed Model for the Houston-Galveston Region,* prepared by Texas A&M Transportation Institute (TTI) for the Houston-Galveston Area Council (H-GAC), March 1993. The model approach used to estimate freeway speeds in the original Houston Speed Models could be described as the Speed Reduction Factor (SRF) approach. This approach is used for freeways, arterials, and collectors.

Using the SRF approach requires estimates of both free-flow speed (i.e., the speed at a v/c ratio approaching 0.0) and the LOS E speed (i.e., LOS E speed, or speed at a v/c ratio of 1.0). The analyst provides these paired speed factors for each functional class and area type that can be applied to the link-data input speed to estimate a link's free-flow speed and LOS E speed. The analyst supplied SRFs describe the general shape of the speed curve for v/c ratios varying from 0.0 to 1.0. These estimate the speeds for v/c ratios between 0.0 and 1.0. The extensions of the models for v/c ratios exceeding 1.0 are based on the traditional Bureau of Public Records (BPR) impedance adjustment function. The following provides a more detailed description of the congested speed estimation process.

The directional v/c ratios, free-flow speeds, and LOS E speeds for a non-directional assignment are calculated as follows:

$$VC1(A, B) = VOL1(A, B) / (CAP24(A, B) \times CAPFAC(AT, FC) \times 0.5)$$

VC2(A, B) = VOL2(A, B) / (CAP24ndir (A, B) × CAPFAC (AT, FC) × 0.5)
SPD0(A, B) = SPD24 × SPD0FAC (AT, FC)
SPD1(A, B) = SPD24 × SPD1FAC (AT, FC)

where,

A, B = the A-Node and B-Node of the link obtained from the link data.
AT = the area type number obtained from the link data.
FC = the functional classification number obtained from the link data.
VC1(A, B) = the estimated time-of-day v/c ratio in one direction.
VC2(A, B) = the estimated time-of-day v/c ratio in the other direction. If the assignment is directional, the VC2 will be 0.0.
VOL1(A, B) = the estimated time-of-day volume in one direction.
VOL2(A, B) = the estimated time-of-day volume in the other direction. If the assignment is directional, the VOL2(A, B) will be 0.0.
CAP24ndir (A, B) = the link's 24-hour non-directional capacity from the assignment data set.
CAPFAC (AT, FC) = the analyst-supplied factor used to estimate time-of-day nondirectional capacity from the 24-hour non-directional capacity. Half of the non-directional time-of-day capacity is used for each direction.
SPD0(A, B) = estimated free-flow speed on link A, B;
SPD1(A, B) = estimated LOS speed (i.e., the expected speed at a v/c ratio of 1.0) on link A, B.
SPD24(A, B) = the input speed for the link data (i.e., the 24-hour input link data speed);
SPD0FAC (AT, FC) = the analyst-supplied factor used to estimate time-of-day free-flow speed from the input link-data speed; and
SPD1FAC (AT, FC) = the analyst-supplied factor used to estimate time-of-day LOS E speed from the link-data input speed.

For directional assignments, the same process discussed previously is used except only one volume and one v/c ratio exist. Since the capacity for the link is also directional, the capacity is not split in half. For a directional assignment, the v/c ratio is calculated as follows:

VC1(A, B) = VOL1(A, B) / (CAP24dir(A,B) × CAPFAC(AT,FC))

where,

CAP24dir (A, B) = the link's 24-hour directional capacity from the assignment data set.

The speed factors are applied to the link's TDM coded speed to estimate the link's free flow speed (i.e., the speed for a v/c ratio approaching 0.0) and the LOS E speed (i.e., the speed for a v/c ratio of 1.0). The SRFs, which essentially describe the shape of the speed curve, are by area type and functional group. These factors are inputs for v/c ratios from 0.0 to 1.0 in increments of 0.05. The analyst-supplied SRFs describe the decay from a free-flow speed to a LOS E speed for a v/c ratio of 1.0. The values of the SRFs vary from 0.0 to 1.0.

The speed model (for v/c ratios from 0.0 to1.0) may be described as:

$$S_{V/C} = S_{0.0} - SRF_{V/C} \times (S_{0.0} - S_{1.0})$$

where,

$S_{V/C}$ = estimated directional speed for the forecast v/c ratio on the link in the selected direction.
$S_{0.0}$ = estimated free-flow speed for the v/c ratio equal to 0.0.
$S_{1.0}$ = estimated LOS E speed for the v/c ratio equal to 1.0.
$SRF_{V/C}$ = SRF for the forecast v/c ratio; and
V/C = the forecast v/c ratio on the link. The v/c ratio can be 0.0 to 1.0.

In TDMs, the traffic assignment model can produce v/c ratios greater than 1.0, hence a model extension like that used in the Houston Speed Model is used. The extension is based on the BPR model where for links with a v/c ratio greater than 1.0 and less than 1.5, the following model extension is used to estimate the link's speed:

$$S_{V/C} = S_{1.0} \times \left(\frac{1.15}{1.0 + (0.15 \times (v/c)^4)}\right)$$

where,

$S_{V/C}$ = estimated directional speed for the forecast v/c ratio on the link in the selected direction;
$S_{1.0}$ = estimated LOS E speed for the v/c ratio equal to 1.0; and
V/C = the forecast v/c ratio on the link. The v/c ratio can be 1.0 to 1.5.

For v/c ratios greater than 1.5, the speed is calculated using the model extension shown above for the v/c ratio of 1.5. Capacity data are not used for centroid connectors and intrazonal links. Thus, for local streets, which these represent, the free-flow speed factors and LOS E speed factors should be defined as 1.0, and the speed reduction factors should be set to 0 for all v/c entries. The operational speed (i.e., assignment speed) for centroid connectors is assumed to be the speed input from the link data.

4.4 Local Street Vehicle Miles Traveled

The roadway network of the regional travel demand model does not contain the details of local (residential) streets. However, a VMT estimate is possible based on data provided by the travel model. Local street VMT is calculated for each county by multiplying the number of intrazonal trips by the intrazonal trip length and then adding the VMT from the zone centroid connectors. The temporal distribution is assumed to be the same as for non-local streets.

4.5 Model Vehicle Miles Traveled Adjustments

Several adjustment factors were applied to this conformity determination. A Highway Performance Monitoring System (HPMS) adjustment factor was applied to the overall VMT from the travel demand model, and seasonal adjustment factors were developed to convert the network to represent an August weekday. The HPMS factors are consistent with model adjustments applied to the 8-hour Ozone Standard Reasonable Further Progress State Implementation Plan (RFP SIP) used to develop the motor vehicle emission budgets applicable to this transportation conformity analysis. The seasonal, daily, and hourly distribution factors used in the RFP SIP are based on Automatic Traffic Recorder (ATR) data over the years 2005-2014. This methodology is consistent with the procedures used by the TTI in developing model adjustment factors for the rest of the State of Texas.

4.5.1 Model Highway Performance Monitoring System Adjustments

In order to compare Base Year 2016 estimated regional VMT to HPMS estimated 2016 VMT, an estimate of total model estimated regional VMT is calculated. Model assigned regional network VMT is combined with assigned regional centroid connector VMT and an estimate of travel within each zone (intrazonal VMT). Because the reconciliation is made for estimated non-summer weekday VMT, both VMT estimates (model and HPMS) are made to represent non-summer weekday VMT. The model VMT is produced in its original form as non-summer weekday VMT, as shown. HPMS VMT represent average annual daily travel (AADT) and is adjusted to represent average non-summer weekday travel, based on an adjusted factor developed using TxDOT permanent traffic recorder data.

2016 HPMS VMT

County	HPMS VMT
Brazoria	8,129,044
Chambers	2,926,505
Fort Bend	11,893,199
Galveston	6,877,234
Harris	104,891,842
Liberty	2,244,970
Montgomery	13,713,224
Waller	2,183,184
Total Non-Toll VMT	**152,859,202**
Brazoria	322
Chambers	26,665
Fort Bend	788,944

Galveston	2,924
Harris	11,042,153
Montgomery	288,880
Total Toll VMT	**12,149,888**
Total 2016 Regional HPMS VMT	**165,009,090**

HPMS estimated average non-summer weekday travel (ANSWT)
= (HPMS AADT) * (AADT to Non-Summer Weekday Travel Adjustment Factor)
= (165,009,090) * (1.06178)
= 175,203,352

CALCULATION OF HPMS ADJUSTMENT FACTOR

The factor used to reconcile model estimated regional VMT to HPMS estimated regional VMT is calculated by dividing the HPMS estimated average non-summer weekday VMT as follows:

HPMS Adjustment Factor
= (HPMS estimated ANSWT) / (Model estimated ANSWT)
= (175,203,352) / (186,710,076)
= 0.93837

APPLICATION OF HPMS ADJUSTMENT FACTOR

The HPMS adjustment factor is applied to the model estimated time-of-day VMT prior to the estimation of time-of-day speed. In this way, the time-of-day speeds used in the estimation of emissions are based upon HPMS adjusted VMT.

4.5.2 Seasonal and Daily Adjustments

Seasonal Corrections Factors

Seasonal adjustment factors are used to adjust the Travel Demand Model (TDM) and estimated intrazonal VMT to summer weekday VMT. The adjustment factors were developed using aggregated Automated Traffic Recorder (ATR) data for the years 2010-2019. These factors, provided in Table 4.4, were calculated by dividing the average day-of-week (weekday) count for the June – August episode by the Annual Non-Summer Weekday Traffic (ANSWT) count.
Two seasonal factors are needed because there are two different sources for data. The counties of Liberty and Chambers belong to the Beaumont TxDOT District while the counties of Harris, Brazoria, Fort. Bend, Galveston, Montgomery, and Waller belong to the Houston TxDOT District.

Table 4.4: Seasonal Correction Factors

	County	Factors
Weekday Summer June to August	Harris, Brazoria, Fort Bend, Galveston, Montgomery, and Waller	1.01341
	Liberty, Chambers	0.98644

*Source: *Data from Texas A&M Transportation Institute*

4.5.3 Hourly Adjustments

The output VMT of the TDM is represented by four time periods (Overnight, AM Peak, Mid-Day, and PM Peak), as described in Table 4.5. The hourly factors in Table 4.6 are used to convert the TDM output into hourly VMT.

Table 4.5: Time Period Designations

Hours	Period Designations
12:00 am – 12:59 am	Overnight
1:00 am – 1:59 am	Overnight
2:00 am – 2:59 am	Overnight
3:00 am – 3:59 am	Overnight
4:00 am – 4:59 am	Overnight
5:00 am – 5:59 am	Overnight
6:00 am – 6:59 am	AM Peak
7:00 am – 7:59 am	AM Peak
8:00 am – 8:59 am	AM Peak
9:00 am – 9:59 am	Mid-Day
10:00 am – 10:59 am	Mid-Day
11:00 am – 11:59 am	Mid-Day
12:00 pm – 12:59 pm	Mid-Day
1:00 pm – 1:59 pm	Mid-Day
2:00 pm –2:59 pm	Mid-Day
3:00 pm – 3:59 pm	PM Peak
4:00 pm – 4:59 pm	PM Peak
5:00 pm – 5:59 pm	PM Peak
6:00 pm – 6:59 pm	PM Peak
7:00 pm – 7:59 pm	Overnight
8:00 pm – 8:59 pm	Overnight
9:00 pm – 9:59 pm	Overnight

Hours	Period Designations
10:00 pm – 10:59 pm	Overnight
11:00 pm – 11:59 pm	Overnight

Table 4.6: Hourly Factors*

HGB region average summer weekday hourly travel factors

Hours Description	Periods	24-hour	4-period
12:00 a.m. – 12:59 a.m.	Overnight	0.009164	0.039330
1:00 a.m. – 1:59 a.m.	Overnight	0.006058	0.026000
2:00 a.m. – 2:59 a.m.	Overnight	0.005639	0.024202
3:00 a.m. – 3:59 a.m.	Overnight	0.006211	0.026656
4:00 a.m. – 4:59 a.m.	Overnight	0.013328	0.057201
5:00 a.m. – 5:59 a.m.	Overnight	0.038017	0.163162
6:00 a.m. – 6:59 a.m.	AM Peak	0.062469	0.334676
7:00 a.m. – 7:59 a.m.	AM Peak	0.066920	0.358523
8:00 a.m. – 8:59 a.m.	AM Peak	0.057266	0.306801
9:00 a.m. – 9:59 a.m.	Midday	0.051661	0.161257
10:00 a.m. – 10:59 a.m.	Midday	0.050387	0.157280
11:00 a.m. – 11:59 a.m.	Midday	0.052108	0.162652
12:00 p.m. – 12:59 p.m.	Midday	0.053986	0.168515
1:00 p.m. – 1:59 p.m.	Midday	0.054713	0.170784
2:00 p.m. –2:59 p.m.	Midday	0.057509	0.179512
3:00 p.m. – 3:59 p.m.	PM Peak	0.062908	0.241973
4:00 p.m. – 4:59 p.m.	PM Peak	0.067456	0.259467
5:00 p.m. – 5:59 p.m.	PM Peak	0.070399	0.270788
6:00 p.m. – 6:59 p.m.	PM Peak	0.059216	0.227772
7:00 p.m. – 7:59 p.m.	Overnight	0.046370	0.199011
8:00 p.m. – 8:59 p.m.	Overnight	0.036011	0.154552
9:00 p.m. – 9:59 p.m.	Overnight	0.031184	0.133836
10:00 p.m. – 10:59 p.m.	Overnight	0.024436	0.104875
11:00 p.m. – 11:59 p.m.	Overnight	0.016584	0.071175

Source: *Data from Texas A&M Transportation Institute – Hourly factors calculated using 2010-2019 ATR data.

4.5.4 Non-Recurring Congestion

Regional travel demand model does not model for non-recurring congestion, and this emission model does not use any adjustment factor developed to account for non-recurring congestion. H-GAC is not aware of any up-to-date, systematic, and empirical studies on observed data which quantifies the impact of non-recurring congestion on emission within the 8-county region.

4.6 Transit Systems

A reflection of the level-of-service experienced by a potential transit user is constructed through development of a computerized network representation of the system of routes and service levels. This computer-coded transit network must be an accurate representation of the individual bus routes, fixed guideway lines, headways, and travel times that define that service. Consistency in representation methods across all alternatives is essential to ensure that differences in travel times between those alternatives are accurate portrayals of service level differences, and not simply differences in coding conventions. Reflection of the choice of "path" or route(s) selected between TAZs within the network is an equally important consideration in properly determining transit supply characteristics. The algorithm which applies the "path-building" step of the process must examine all the possible ways in which a transit user could travel on one or more transit lines between each OD pair of TAZs. This algorithm selects the path that involves the minimum inconvenience in terms of in-vehicle time, wait time, transfer time, and access to the service.

4.6.1 Transit Vehicle Miles Traveled

The mode choice model forecasts number and the locations of the transit trips. The transit trips are excluded from the highway assignment and do not contribute to roadway VMT.

4.7 Roadway Vehicle Miles Traveled

Roadway VMT is provided by hour, county, road type and area type. Appendix 18 contains .tab files of all the network years with the final VMT estimates, which are submitted electronically through H-GAC website.

4.7.1 Average Loaded Speeds

Average Loaded Speeds are provided by hour, county, road type and area type in the same .tab files provided for the Roadway VMT. As stated above, this data is provided electronically through H-GAC website in Appendix 18.

4.7.2 Centerline and Lane Miles

The table below shows the centerline (CL) and lane (LN) miles for the 8-county region for each conformity year.

Table 4.7: Centerline and Lane Miles

Year	Centerline (CL) Miles	Lane (LN) Miles
2023	8,586	28,300
2026	8,604	28,766
2030	8,751	30,563
2040	8,805	31,461
2045	8,830	31,800

Chapter 5: ESTIMATION OF OFF-NETWORK ACTIVITY

The off-network activity was calculated by Texas A&M Transportation Institute. The off-network activity includes Off-network idling (ONI) hours, source hours parked (SHP), starts, and long-haul combination truck hoteling hours (split into various fractions of activity, such as Extended Idle Exhaust (SHE)I and diesel Auxiliary Power Unit (APU) hours. These quantities are estimated for each hour of the day at a spatial scale of a county and for each vehicle type.

The off-network emissions are calculated by multiplying rate per activity emission factors by the scenario specific activity.

5.1 Vehicle Populations

Vehicle population data were used to estimate SHP and vehicle starts off-network activity. The vehicle population estimates were derived from end of year 2018, county-specific vehicle registration data provided by the TxDMV, TxDOT district level VMT mix data, and HPMS-reported county-level VMT totals.

A single set of vehicle population data inputs were used for each conformity analysis year (i.e., the model assumes that vehicle populations remain constant across seasons and day types).

The end of year 2018 TxDMV vehicle registration data was provided in the form of total vehicles registered by county, aggregated by the vehicle categories shown in the first column of Table 33. These TxDMV vehicle categories were disaggregated to MOVES SUT and fuel type aggregations shown in the corresponding row of the second column of Table 5.1. For clarity, it is useful to distinguish between the vehicle registration data (provided by TxDMV and aggregated according to the first column of Table 5.1) and vehicle population data comprising estimates of the number of vehicles in each vehicle type (MOVES SUT and fuel type) classification. As previously mentioned, in MOVES emissions analyses we use the term vehicle type as synonymous with MOVES SUT and fuel type combination.

The following steps were used to disaggregate the TxDMV vehicle registration data to vehicle population data by vehicle type.

1. VMT mix data was used to calculate the proportional representation of each MOVES vehicle type within each TxDMV aggregation class (first column of Table 5.1).

2. The proportional fractions calculated in Step 1 were multiplied by the total number of vehicles reported in each TxDMV vehicle registration category to obtain the estimated number of vehicles (populations) for each modeled MOVES vehicle type.

3. The long-haul truck vehicle type populations (see the last row of Table 5.1) were estimated as an extension of their estimated short-haul vehicle type population counterparts. This was accomplished by multiplying a long-haul-to-short-haul ratio derived from the weekday vehicle type VMT mix, by the associated short-haul truck vehicle type populations, from Step 2.

The VMT mix data used in these calculations was the TxDOT district-level, 24-hour weekday VMT mix described in more detail in the "Vehicle Type VMT Mix" section and included in Appendix 7.

The methods above yielded 2018 vehicle population data for each of the vehicle types modeled in the conformity years.

Analysis year vehicle type populations were then calculated by applying a vehicle types population growth factor (VPGF). The VPGF was calculated using county-level HPMS reported total VMT for the registration data year (2018) and each analysis year (2023, 2026, 2030, 2040 and 2045).

VPGF = Analysis Year VMT / Registration Year VMT

Table 5.1: TxDMV Registration Aggregations for Estimating Vehicle Populations

Vehicle Registration[1] Aggregation	Associated Vehicle Type[2]
Motorcycles	MC_Gas
Passenger Cars (PC)	PC_Gas; PC_Diesel
Trucks ≤ 8.5 K GVWR (pounds)	PT_Gas; PT_Diesel; LCT_Gas; LCT_Diesel
Trucks > 8.5 and ≤ 19.5 K GVWR	RT_Gas; RT_Diesel SUShT_Gas; SUShT_Diesel MH_Gas; MH_Diesel OBus_Gas: OBus_Diesel TBus_Gas; TBus_Diesel SBus_Gas; SBus_Diesel
Trucks > 19.5 K GVWR	CShT_Gas; CShT_Diesel
NA[1]	SULhT_Gas; SULhT_Diesel CLhT_Gas; CLhT_Diesel

[1] The four long-haul SUT/fuel type populations are estimated using a long-haul-to-short-haul weekday SUT VMT mix ratio applied to the short-haul SUT population estimate.
[2] The year-end TxDMV county registrations data extracts were used (consisting of 1—light-duty cars, trucks, and motorcycles; 2—heavy-duty diesel trucks; and 3—heavy-duty gasoline trucks) for estimating the vehicle populations

[1] TTI Emission Inventory Estimation Utilities Using MOVES: MOVES2014aUtl User's Guide, August 2016*5.1.1 Vehicle Type Total Available Hours*

5.2 ONI Hours

Off-network idling, or ONI, is idling activity that occurs while a vehicle is idling in a parking lot, drive-through, driveway while waiting to pick up passengers or loading/unloading cargo. ONI applies to all MOVES source types.

TTI estimates ONI hours activity (i.e., source hours idling [SHI] off-network) for each hour of the day using the following formula.

ONI hours = (SHOnetwork x TIF− SHInetwork) / (1−TIF).

Where:

SHOnetwork is the source hours operating on each link. This is calculated by dividing the VMT associated with each link by the link's congested speed.

SHInetwork is the total source hours idling that occurs on the network (idling that occurs as a component of drive cycles) and is calculated by multiplying SHOnetwork by a road idle fraction (RIF). RIF is the proportion of idling (in units of time) that occurs within a drive-cycle at a specified operational speed. Default values for RIF were used as defined in the MOVES data table "roadidlefraction".

TIF is the total idle fraction or total idling time on and off-network divided by total SHO on and off-network: *TIF = (SHInetwork + ONI) / (SHOnetwork+ ONI).* Default values for TIF were used as defined in the MOVES data table "totalidlefraction".

5.3 SHP

County-level vehicle type SHP was calculated for each hour of the day and each vehicle type as the difference between the local vehicle population (total available vehicle hours) minus source operating hours (SHO).

Adjusted SHP was then calculated by subtracting ONI hours from the previously calculated SHP.

5.4 Vehicle Starts

Vehicle starts were estimated using county-level vehicle type populations, and data from MOVES representing the average number of vehicle starts per vehicle type per hour.

The starts per vehicle were calculated using MOVES with data on the age distribution and fuel fractions of the local fleet. TTI used local age distributions and fuel fractions inputs to MOVES combined with MOVES default parameters (startsageadjustment, startsmonthadjust [June through August average], and startspervehicle) to produce hourly starts per vehicle output representative of the June through August summer period. The output was then post-processed to produce the scenario-specific starts per vehicle for the summer (or non-school) period defined by the study scope.

MOVES was used to calculate starts per vehicle (i.e., the average number of starts per vehicle type per hour) for weekday day type for the June through August summer period. To produce the scenario-specific non-school period (10 June through 10 August), the MOVES output summer period starts per vehicle were multiplied by conversion factors based on period weighted average MOVES default startsmonthadjust data. Using the startsmonthadjust default data, the non-school conversion factor is the ratio of non-school-period-to-average June through August summer period.

For each hour of the day, the MOVES starts per vehicle data were multiplied by the local vehicle type population estimates to produce the total number of starts by vehicle type per hour.

5.5 Hoteling: SHEI and APU

Hoteling hours were calculated for heavy-duty, long-haul trucks only (i.e., SUT 62) in several steps. First total hoteling hours were calculated using information from a TCEQ extended idling study[1]. Scaling factors were then used to convert these base hoteling hours to those relevant to each analysis year, which were then allocated to each hour of the day. Estimations were then made of the proportions of hoteling hours that occur in each of the four hoteling categories: idling using the main engine (SHEI), diesel APU operation, electric APU operation, or main engine off and no auxiliary power[2].

5.5.1 Estimating 24-Hour Hoteling

County-level hoteling scaling factors were developed to transform base 2017 winter weekday total daily hoteling hours to daily hoteling hours for each conformity analysis year scenario. Scaling factors were calculated using the ratio of heavy-duty long haul VMT for each scenario relative to heavy-duty long haul VMT for a 2017 winter weekday (scenario SUT 62 VMT divided by 2017 winter weekday SUT 62 VMT).

Total daily hoteling for each county and scenario was calculated by multiplying the appropriate scaling factor by the total daily hoteling hours contained in the 2017 winter weekday total daily hoteling hours study.

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1. Heavy-Duty Vehicle Idle Activity Study, Final Report. Texas A&M Transportation Institute, Environment and Air Quality Division, July 2019.

2. Note that only SHEI and APU diesel hoteling generate emissions. The other fractions are calculated for completeness.

5.5.2 Hoteling by Hour Estimation

Daily hoteling hours were allocated to each hour of the day as a function of the inverse of activity scenario hourly VHT fractions for SUT 62. The hourly VHT fractions were calculated using the hourly VHT from the SHP estimation process (VHT = SHO). The inverses of these hourly VHT fractions were calculated and then normalized across all hours to produce the county-level, hoteling hours hourly distribution.
If the hourly hoteling hours (as calculated above) were greater than SHP (for SUT 62), the final hoteling hours estimate was set to the SHP.

5.5.3 SHEI and APU Hours

The hourly, county-level, hoteling estimates were then factored to calculate SHEI and diesel APU hours activity components using extended idle and APU fractions. The SHEI and APU fractions were derived using MOVES default SUT 62 hoteling operating mode distributions by model year. The MOVES SHEI and APU hoteling distributions[1] are shown in Table 5.2. Note that only SHEI and diesel APU are used to calculate emissions.

Table 5.2: Hoteling Activity Distributions by Model Year

First Model Year	Last Model Year	200 Extended Idling	201 Hotelling Diesel Aux	203 Hotelling Battery AC	204 Hotelling APU Off
1960	2009	0.80	0	0	0.20
2010	2020	0.73	0.07	0	0.20
2021	2023	0.48	0.24	0.08	0.20
2024	2026	0.40	0.32	0.08	0.20
2027	2060	0.36	0.32	0.12	0.20

[1].Current MOVES defaults (previously adopted while in draft stage for use in the TCEQ 2017 truck extended idling study)

Chapter 6: REGIONAL AIR QUALITY TRANSPORTATION EMISSIONS MODEL AND RESULTS

6.1 Overview

Eastern Research Group, Inc. (ERG) and Cambridge Systematics, Inc. developed a modeling framework, the Spatial Emissions Estimator (SEE), for estimating regional on-road emission inventories of criteria, toxic, and GHG emissions for each hour of a day. SEE provides highly detailed spatial resolution at the link level. This framework employs the latest version of the U.S. EPA mobile emissions model, MOVES3.1[1], at the County Scale Rate Mode to calculate emission factors for on-network and off-network activities. SEE generates emissions factors (in grams/mile) for 13 vehicle categories for a wide variety of emission processes. The calculation methodologies for this conformity are consistent with the procedures used to estimate the emission budgets in the RFP SIP. The emission factors are combined with the activity output (either VMT, SHP, hours of hoteling, or starts) to generate the final emissions per vehicle type, fuel type, and road type for the on-road network and per vehicle type and fuel type for off-network activity. The equation below describes the overall calculation.

Vehicle Emissions = Vehicle Activity x Emission Rate

6.2 Emissions Factor Estimation Model

EPA's MOtor Vehicle Emission Simulator (MOVES) is a state-of-the-science emission modeling system that estimates emissions for mobile sources at the national, county, and project level for criteria air pollutants, greenhouse gases, and air toxics. Its latest version is MOVES3.1, which by federal regulations is required to be used for conformity since January 9, 2023. This model is used to generate emission factors for 13 different types of vehicles according to their ages and fuel used. These emission factors are sensitive to speed, temperature, and humidity. The analysis years used to calculate emission factors for this conformity are identified in Chapter 2, Table 2.3.

This new version of MOVES accounts for the implementation of the following new regulations:

- Greenhouse Gas Emissions and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines Vehicles-Phase 2[2]
- Safer Affordable Fuel Efficient (SAFE) Vehicles Rule[3]

A full list of MOVES3.1 input parameters can be found in Appendix 9. These parameters include the Texas Department of Motor Vehicle (TxDMV) Registration, fuel supply, fuel formulation,

[1] https://www.epa.gov/moves/latest-version-motor-vehicle-emission-simulator-moves
[2] https://www.epa.gov/regulations-emissions-vehicles-and-engines/final-rule-phase-2-greenhouse-gas-emissions-standards
[3] https://www.epa.gov/regulations-emissions-vehicles-and-engines/safer-affordable-fuel-efficient-safe-vehicles-final-rule

meteorology, and Inspection and Maintenance (I/M) programs. The mentioned parameters correspond to the parameters used in the modeling for the RFP SIP, except where more recent planning assumptions have replaced the earlier data. Newer data from the previous conformity includes updated fuel formulation, Texas Low Emission Diesel Adjustments (TxLED), and new I/M compliance factors. It should also be noted that there is no I/M program in the rural counties.

Appendix 9 presents all data inputs, including local meteorological data, state control programs, federal control programs, and vehicle fleet characteristics.

6.3 Adjustments to Emission Factors

The NOx emission factors calculated by MOVES need to be adjusted due to the use of TxLED in Texas, which produces lower NOx emissions than the national low emission diesel fuel. The 2023 and 2026 TxLED factors were produced by TCEQ, based on MOVES3.1 inventory mode output (using Texas statewide age distributions and fuel fractions inputs based on 2018 end-of-year TxDMV vehicle registration data) and TCEQ's spreadsheet TxLED factor calculation procedure available at the TCEQ public FTP site.

To access this FTP site, users will need to download FTP client software for their operating system. Popular free FTP clients include FileZilla or Cyberduck, among others. Once downloaded and installed, users will need to enter the following information into their chosen client:

FTP Address: amdaftp.tceq.texas.gov
FTP Directory: /EI/onroad/txled
User ID: anonymous
Password: users email address

The 2030 factors were estimated by TTI using MOVES3.1 and 2018 registration data consistent with TCEQ methodology. The 2032 and later analysis years TxLED factors are constant, hence 2040 and 2045 factors are the same.

These factors are listed below and in Appendix 10.

6.3.1 Low Emissions Diesel NO_X Adjustment

Table 6.1 – Texas Low Emission Diesel Adjustment Factors

Source Use Type	2023 Reduction	2026 Reduction	2030 Reduction	2040 Reduction	2045 Reduction	2023 Factor	2026 Factor	2030 Factor	2040 Factor	2045 Factor
Passenger Car	4.86%	4.83%	4.83%	4.80%	4.80%	0.9514	0.9517	0.9517	0.9520	0.9520
Passenger Truck	5.11%	5.02%	4.92%	4.80%	4.80%	0.9489	0.9498	0.9508	0.9520	0.9520
Light Commercial Truck	5.15%	5.06%	4.97%	4.80%	4.80%	0.9485	0.9494	0.9503	0.9520	0.9520
Intercity Bus	5.19%	5.06%	4.89%	4.80%	4.80%	0.9481	0.9494	0.9511	0.9520	0.9520
Transit Bus	4.92%	4.88%	4.84%	4.80%	4.80%	0.9508	0.9512	0.9516	0.9520	0.9520
School Bus	5.06%	4.97%	4.85%	4.80%	4.80%	0.9494	0.9503	0.9515	0.9520	0.9520
Refuse Truck	5.05%	4.92%	4.81%	4.80%	4.80%	0.9495	0.9508	0.9519	0.9520	0.9520
Single Unit Short-Haul Truck	4.82%	4.81%	4.80%	4.80%	4.80%	0.9518	0.9519	0.9520	0.9520	0.9520
Single Unit Long-Haul Truck	4.84%	4.82%	4.81%	4.80%	4.80%	0.9516	0.9518	0.9519	0.9520	0.9520

Motor Home	5.33%	5.17%	4.92%	4.80%	4.80%	0.9467	0.9483	0.9508	0.9520	0.9520
Combination Short-Haul Truck	4.87%	4.83%	4.81%	4.80%	4.80%	0.9513	0.9517	0.9519	0.9520	0.9520
Combination Long-Haul Truck	4.93%	4.86%	4.82%	4.80%	4.80%	0.9507	0.9514	0.9518	0.9520	0.9520

Source: Texas A & M Transportation Institute

6.4 Modeled Emission Estimation

6.4.1 VMT Mix

VMT mix (or fractions) is very important to be able to estimate link emissions. The VMT mix is applied to the emission factors in a post-process methodology. The VMT mix enables the assignment of emission factors by vehicle type to VMT to calculate emissions on a specified roadway facility or functional class. VMT mix is estimated for four MOVES roadway types: Rural Restricted (rural freeways), Rural Unrestricted (rural arterials and collectors), Urban Restricted (urban freeways), and Urban Unrestricted (urban arterials and collectors) for daily time periods for each of the modeled counties. Each county's roadway sections are classified as rural or urban by the vehicle activity behavior and the demographics of the county. The VMT mix methodology utilizes data, assumptions, and procedures from the Texas Department of Transportation (TxDOT), TTI, and the Houston region travel demand model.

TTI developed these weekday VMT mixes using new Vehicle Classification Count (VCC) data (2009 through 2018) and TxDMV vehicle registration data (2018 end-of-year data) and the same method/procedures as used on TTI's VMT mix method (Methodologies for Conversion of Data Sets for MOVES Model Compatibility. Texas A&M Transportation Institute, August 2009). The VMT mix was estimated for each TxDOT district associated with the 8-county HGB area (i.e., Houston and Beaumont districts). The VMT mixes were developed for the years 2025, 2030, 2035, 2040 and 2045. The following table (Table 6.2) indicates the relation between the VMT Mix year and the conformity analysis year.

Table 6.2: VMT Mix and conformity analysis years correlations

VMT Mix Year	Analysis Years
2025	2023 through 2027
2030	2028 through 2032
2035	2033 through 2037

2040	2038 through 2042
2045	2043 through 2047

This data is included in Appendix 9 of final conformity report.

6.4.2 Flow of Calculations

The flow of calculations done by the SEE model are represented in Figure 6.1 and as follows:

1. The SEE model uses MOVES as an emission factor generator. The calculated emission factors are for all counties of the non-attainment region, all roadways, all vehicle types, all fuels, all processes, all MOVES speed bins, and for all hours of a weekday. The pollutants calculated are NOx and VOCs.

2. The NOx emission factors are adjusted due to the use of TxLED.

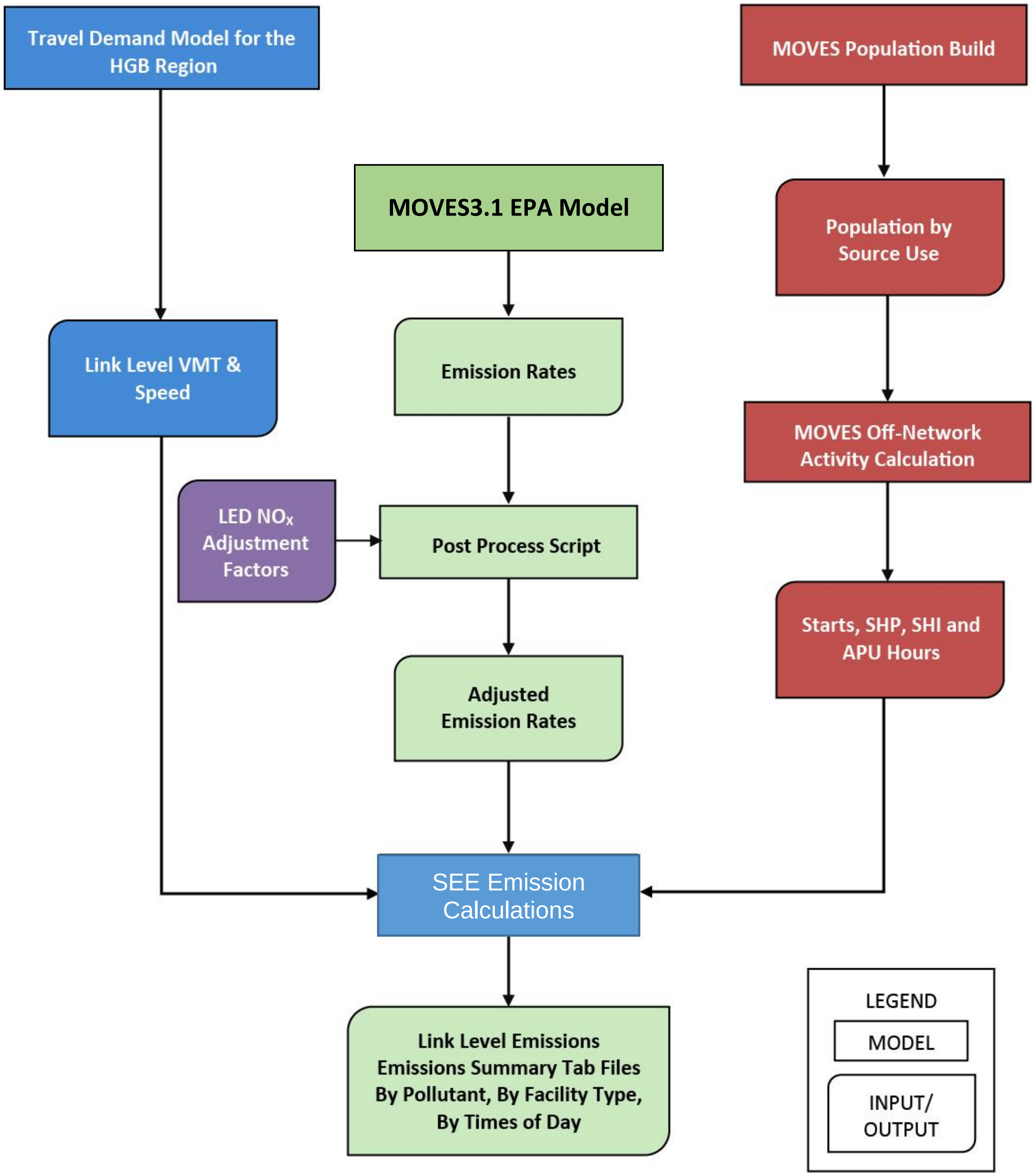
3. The next step is interpolation of the emission factors. MOVES rate mode generates emission factors or emission rates by average speed bin, which are generally 5 mph bins. To estimate emissions with the same level of precision as TCEQ's inventories, these rates are interpolated to three decimal places using harmonic averaging to generate rates for the intermediate speeds.

4. For on-network: the adjusted emission factors, expressed in grams/mile, are combined with the links coming from the TDM using the link average speeds and interpolated emission rates. The total emissions for on-network are calculated by multiplying the VMT by hour, road type, source type, and fuel type with the corresponding emission factors for all the links depending on the speed. Results are then summed, and the total On-network emissions are expressed in kilograms.

5. For off-network: the adjusted emission factors for off-network activities (activities = starts, idling, hoteling, hours parked), expressed in grams/activity are multiplied with the different activities generated from off-network, as explained in Chapter 5, to calculate the off-network emissions. These emissions are summed up to generate the total off-network emissions. The total off-network emissions are expressed in kilograms.

6. The final emissions per county are calculated by summing the on-network final emissions with the off-network final emissions.

Figure 6.1: Flow of SEE Model Calculations



The tables below show the final modeled emission results.

Table 6.3: Modeled Emissions Analysis Results Versus MVEBs from RFP SIP for serious classification

Year	NOx Emissions (tpd)*	NOx Budget (tpd)	VOC Emissions (tpd)	VOC Budget (tpd)	VMT
2023	60.46	87.69	34.49	57.70	207,127,974
2026	49.81	87.69	29.66	57.70	218,020,232
2030	43.91	87.69	26.03	57.70	237,879,429
2040	42.91	87.69	23.07	57.70	279,828,518
2045	45.27	87.69	23.27	57.70	298,902,646

* tpd = tons per day

Chapter 7: MOBILE SOURCE EMISSION REDUCTION STRATEGIES

7.1 Transportation Control Measures

A TCM is a measure specifically committed to in a SIP for reducing emissions from transportation sources. TCMs are further defined in 40 CFR 93.101, as amended by 62 FR 43780. The CAAA required that TCMs be included in SIPs for regions designated as serious and above ozone nonattainment areas. The TCMs committed to in the previous SIPs are listed in Appendix 12.

7.1.1 Timely Implementation of Transportation Control Measures

The transportation conformity rule includes specific criteria for determining if TCMs that are included in a SIP are being implemented in a timely manner. The intent of these provisions is to ensure that TCMs which are eligible for federal funding receive priority and that the SIP schedules and commitments are enforced. The TCM Appendix 12, has emission estimates associated with each project. While emissions were calculated for each project, these credits were not applied in this conformity analysis.

Table 7.1 identifies the applicable SIP actions which committed TCMs.

Table 7.1: Transportation Control Measures

Committed Transportation Control Measures
1. 2000 HGB RFP and AD SIP, Approved Nov. 2001 ID#2000-0826-SIP 2. 2004 HGB Mid-Course Review SIP, Approved Dec. 2004 ID# 2004-42-NR 3. TCM Substitution for HGB 2006 4. 2010 HGB AD SIP for the 1997 8-hr Ozone Standard (2009-017-SIP-NR)

This conformity did not use any credits from voluntary mobile emission reduction programs or TCMs since they were not needed to show conformity to the emission budgets.

7.2 Voluntary Mobile Emission Reduction Programs (VMEPS)

Currently there are no VMEPS associated with the Air Quality SIP.

7.3 Transportation Emission Reduction Measures

The H-GAC has a number of transportation emission reduction measures (TERMs) or locally implemented strategies in the HGB nonattainment area including projects, programs, partnerships, and policies. The following is a summary of these strategies.

- **Commute Solutions** program works with businesses, local governments, and other organizations to promote travel alternatives to reduce traffic and improve air quality in the region. Strategies include: carpooling, vanpooling, transit, walking, biking, teleworking, and working a compressed workweek.
- **Active Transportation** efforts help to enable communities to be less dependent on motor vehicles and make streets safer for those who walk or bicycle. This can encourage the use of non-motorized transportation options with a resulting decrease in ozone precursor emissions.
- **METRO STAR VanPool** receives support to provide ridesharing services for commuters within the region.
- **The Commuter and Transit Services Pilot Program** supports the development of new and innovative commuter transit services.
- **The Houston-Galveston Clean Cities Coalition** works to assist fleets throughout the region to better understand the benefits of alternative fuels and helps local businesses locate and secure funding for alternative fuel vehicle projects.
- **The Clean Vehicles Program** provides grant assistance to local governments, school districts, and businesses operating in the region to retrofit and replace high-emitting heavy-duty vehicles with newer, cleaner models.
- **The Gulf Coast Regional Tow and Go Program** provides highway motorists with no-cost towing when their vehicle breaks down within the eight-county H-GAC region.
- **The Transportation Safety Program** of the Houston-Galveston MPO is a multi-faceted effort to address the region's many traffic safety challenges.
- **The Livable Centers Program** works with local communities to conduct planning studies that identify specific recommendations that can help create places where people can live, work, and play with less reliance on their cars and support more trips by foot, bicycle, transit, or carpool.

H-GAC also distributes funding related to the FHWA's Congestion Mitigation and Air Quality (CMAQ) program. Improvements funded under this program result in more consistent travel speeds and reduced delays on regional roadways which leads to decreased emissions. Examples of projects funded under this program include:

- Improvements to intersections including left and/or right turn lanes to decrease the amount of time automobiles are left idling at intersections.
- Improving traffic signals using retiming coordination; implementation of Intelligent Transportation Systems (ITS).
- High occupancy vehicle (HOV) and high occupancy toll (HOT) projects promote the use of managed lanes through carpooling or the levying of tolls.

7.4 Final Emissions Analysis Results

Since TERMs or TCMs will not be required to demonstrate conformity for the 2045 RTP Update and amended 2023-2026 TIP, H-GAC, with consensus from the consultation partners, decided to list the TERMs and TCMs in the conformity documentation but not to apply emissions reductions from them to any analysis year for this conformity demonstration.

Please find in Table 7.2 the final results for this conformity determination.

Table 7.2: Final Emission Results versus HGB Serious RFP SIP MVEBs

Year	NOx Emissions (tpd)*	NOx Budget (tpd)	VOC Emissions (tpd)	VOC Budget (tpd)	VMT
2023	60.46	87.69	34.49	57.70	207,127,974
2026	49.81	87.69	29.66	57.70	218,020,232
2030	43.91	87.69	26.03	57.70	237,879,429
2040	42.91	87.69	23.07	57.70	279,828,518
2045	45.27	87.69	23.27	57.70	298,902,646

* tpd = tons per day

The results of this conformity determination demonstrate that the 2045 RTP Update and the amendments to the 2023-2026 TIP for the HGB TMA conform to the SIP for the HGB ozone non-attainment area and are in accordance with the Clean Air Act (42 U.S.C., 7506 (c) and (d)), as amended on November 15, 1990, and the final conformity rule (40 CFR Parts 51 and 93).

Chapter 8: INTERAGENCY CONSULTATION

8.1 Process Description

Interagency review and comments on the conformity finding was conducted in accordance with the consultative process identified in the Conformity SIP and as required by 40 CFR 93.112. Local, state, and federal transportation and air quality agencies affected by this conformity analysis were consulted on the scope, methodologies and products of the conformity finding. A conformity steering committee (Conformity Consultation Committee (CCC)) composed of representatives of each of the following agencies was consulted regularly during the conformity process:

- Houston-Galveston Area Council (H-GAC)
- Metropolitan Transit Authority of Harris County (METRO)
- Texas Department of Transportation (TxDOT)
- Texas Commission on Environmental Quality (TCEQ)
- Texas Transportation Institute (TTI)
- Federal Highway Administration (FHWA)
- Federal Transit Administration (FTA)*
- U.S. Environmental Protection Agency (EPA)

The purpose of this group was to ensure that the modeling methodology utilized in this conformity analysis was consistent with the on-road modeling utilized in the SIP and that the most recent planning assumptions were used. A comprehensive list of the CCC meeting agenda and decisions can be found in Appendix 14.

*Note: FHWA acts as executive agent for the FTA

Chapter 9: PUBLIC PARTICIPATION

9.1 Process Description

Public participation is an important (and required) part of the conformity process. All draft information was shared with the public via H-GACs website: https://www.h-gac.com/transportation-conformity/2023.

The public comment period began on Wednesday, March 15, 2023 and ended on Monday, April 17, 2023 at 5:00 p.m. A virtual public air quality conformity meeting was held on Tuesday, March 21, 2023, at 1 p.m. The public meeting, including the website announcement, meeting format, presentation, questions asked/answered and exit survey is documented in Appendix 15. Once US DOT issues its conformity determination, H-GACs conformity website will be updated.