



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

For Amendments to the 2045 Regional
Transportation Plan and to the 2021-2024
Transportation Improvement Program

Agency in Charge:
Houston-Galveston Area Council
3555 Timmons Lane, Suite 120, Houston, Texas 77027

Contact Person:
Graciela Lubertino, PhD
Principal Data Analyst of the Transportation Department

Preface

What is the Houston-Galveston Area Council?

The Houston-Galveston Area Council (H-GAC) is the designated Metropolitan Planning Organization (MPO) for the eight-county Houston-Brazoria-Galveston 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

List of Transportation Policy Council and Technical Advisory Committee Members

<http://h-gac.com/taq/transportation-committees/TPC/members.aspx>

<http://h-gac.com/taq/transportation-committees/TAC/membership.aspx>

Glossary of Abbreviations

The Glossary of Abbreviations are linked at the following location:

http://www.h-gac.com/taq/airquality_model/conformity/acronyms.aspx

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.

Table of Contents

Executive Summary

Chapter 1: Introduction

1.1 Reasons for Conformity Determination	1
1.2 Timeline	2

Chapter 2: Air Quality Conformity

2.1 What is Transportation Conformity?	3
2.2 Conformity Requirements	3
2.3 Checklist	4
2.4 Emissions Analysis	6
2.4.1 Regional Inventory	7
2.4.2 Emissions Tests	7
2.4.3 Analysis Years	8

Chapter 3: Regional Transportation Plan and Transportation Improvement Program

3.1 Regional Transportation Plan	9
3.1.1 Overview	9
3.1.2 Submittal Frequency	9
3.1.3 Fiscal Constraint	9
3.2 Transportation Improvement Program	10
3.2.1 Overview	10
3.2.2 Submittal Frequency	10
3.2.3 Fiscal Constraint	10
3.3 Regionally Significant Travel Projects/Programs	11
3.4 Non-Federal Projects/Programs	13
3.5 Exempt Projects/Programs	13

Chapter 4: Estimation of Vehicle Activity

4.1 Travel Model Overview	14
4.2 Multimodal Transportation Analysis Process	
4.2.1 Trip Generation Model	15
4.2.2 Trip Distribution Model	18
4.2.3 Mode Choice Model	18
4.2.4 Roadway Assignment Model	19
4.3 Speed Estimation Procedure	21

4.4 Local Street Vehicle Miles Traveled	23
4.5 Model Vehicle Miles Traveled Adjustments	23
4.5.1 Model Highway Performance Monitoring System Adjustments	23
4.5.2 Seasonal and Daily Adjustments	25
4.5.3 Hourly Adjustments	25
4.5.4 Non-Recurring Congestion	27
4.6 Transit Systems	27
4.6.1 Transit Vehicle Miles Traveled	27
4.7 Roadway Vehicle Miles Traveled	28
4.7.1 Average Loaded Speeds	28
4.7.2 Centerline and Lane Miles	28

Chapter 5: Estimation of Off-Network Activity

5.1 Estimation of Source Hours Parked	29
5.1.1 Vehicle Type Vehicle Hours Travelled	30
5.2 Estimation of Starts	30
5.3 Estimation of Source Hours Idling and Auxiliary Power Unit Hours	30
5.3.1 Hoteling Activity Scaling Factors	30
5.3.2 Hoteling Activity Hourly Factors	31
5.3.3 County Level Fuel Type 2 (CLhT_Diesel) Hoteling Activity by Hour Estimation	31
5.3.4 County-Level Fuel Type 2 (CLhT_Diesel) Source Hours Idling and Auxiliary Power Unit Hours Estimation	31

Chapter 6: Regional Air Quality Transportation Emissions Model and Results

6.1 Overview	33
6.2 Emissions Factor Estimation Model	33
6.3 Adjustments to Emission Factors	34
6.3.1 Low Emissions Diesel NO _x Adjustment	34
6.4 Modeled Emission Estimation	34
6.4.1 VMT Mix	34
6.4.2 Flow of Calculations	35
6.5 Modeled Emissions Analysis Results	37

Chapter 7: Mobile Source Emission Reduction Strategies

7.1 Transportation Control Measures	38
7.1.1 Timely Implementation of Transportation Control Measures	38
7.2 Final Emissions Analysis Results	38

Chapter 8: Interagency Consultation

8.1 Process Description 40

Chapter 9: Public Participation

9.1 Process Description 41

List of Appendices

- Appendix 1: Resolution from Transportation Policy Council
- Appendix 2: Applicable SIP Excerpts
- Appendix 3: Project Listing
- Appendix 4: Travel Model Validation
- Appendix 5: Final RTP Link Listing
- Appendix 6: MOVES information and Fact Sheets
- Appendix 7: MOVES input parameters
- Appendix 8: SEE Report
- Appendix 9: MOVES input files
- Appendix 10: Post Process (TxLED adjustment)
- Appendix 11: Final MOVES emission factors
- Appendix 12: Transportation Control Measures in the State Implementation Plan
- Appendix 13: VMEPs
- Appendix 14: Interagency Conformity Consultation Process
- Appendix 15: Public Comment process
- Appendix 16: Summary Output Files from SEE
- Appendix 17: Pre-Analysis Consensus Document
- Appendix 18: Output VMT and Speeds
- Appendix 19: Output Off-Network Activity

List of Exhibits

Table 2.1:	Conformity Checklist
Table 2.2:	HGB Moderate RFP SIP 2017 MVEBs
Table 2.3	HGB Serious RFP SIP 2020 MVEBs
Table 2.4	Conformity Analysis Years
Figure 3-1:	Regionally Significant Transportation Facilities
Figure 4.1:	Traditional 4-Step Model General Procedure
Table 4-1:	Year 2040 County Households from H-GAC's Regional Growth Forecast
Table 4.2:	Year 2040 County Employment from H-GAC's Regional Growth Forecast
Figure 4.2:	Mode Choice Model Structure
Table 4.3:	Travel Demand Model
Table 4.4:	Seasonal Correction Factors
Table 4.5:	Time Period Designations
Table 4.6:	Hourly Factors
Table 4.7:	Centerline and Lane Miles
Table 6.1:	Texas Low Emission Diesel Adjustment Factors
Table 6.1:	VMT Mix Year/Analysis Year Correlations
Figure 6.1:	Flow of SEE Model Calculations
Table 6.2:	Conformity Analysis Results versus HGB Moderate RFP SIP MVEBs
Table 6.3:	Conformity Analysis Results versus HGB Serious RFP SIP MVEBs
Table 7.1:	Transportation Control Measures
Table 7.2:	Final Emission Results versus HGB Moderate RFP SIP MVEBs
Table 7.3:	Final Emission Results versus HGB Serious RFP SIP MVEBs

Executive Summary

Milestones and Background

On August 2, 2019, the Federal Highway Administration (FHWA) and the Federal Transit Administration (FTA) certified that the Houston-Brazoria-Galveston region's 2045 Regional Transportation Plan (RTP) and the 2019-2022 Transportation Improvement Program (TIP) met all the requirements for a joint conformity determination to the Air Quality State Implementation Plan (SIP) for the Houston-Galveston-Brazoria (HGB) ozone nonattainment area.

This new conformity determination is being prepared to support the amendments to the 2045 RTP and update to the 2021-2024 TIP. These amendments will increase the total expenditure of the 2045 RTP by approximately \$9 Billion

Major elements of the amendments include:

- a. Construct Express lanes on IH 610 between IH 10 and IH 69
- b. Construct 2-way HOV lanes on IH 10 W between IH 610 west loop and IH 45 N
- c. Construct SH 35 6 lane freeway between Dixie Dr and City of Alvin.
- d. Change the Scope of Hempstead highway (US 290) between IH 610 to Grand Parkway (SH 99)
- e. Reconstruct and widen San Jacinto river bridge on IH 10 E
- f. Reconstruct Houston Ship Channel Bridge on IH 610 E
- g. Reconstruct IH 610 S between SH 35 (Mykawa Rd/SS 5) and SH 288 and IH 610 direct connectors at SH 35 (Mykawa Rd/SS 5)
- h. Widen Grand Parkway (SH 99) by adding Segments E and F.
- i. Reconstruct and Widen Beltway 8 (BW 8) frontage roads between E of Hardy Toll Rd to E of Aldine Westfield Rd
- j. Convert SH 288 to Freeway between future SH 99 to FM 1452
- k. Advance the IH 45 N interchange change at IH 10 W reconstruction and addition of IH 10 express lanes and IH 45 managed lanes part of the North Houston Highway Improvement Project (NHHIP) Segment 3 project to FY 2022.

In accordance with [23 CFR§450.324](#) 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.

Due to the timing of this conformity determination and the U.S. Environmental Protection Agency's (EPA) pending approval of a new Reasonable Further Progress (RFP) SIP for the HGB area, this conformity will demonstrate compliance to Motor Vehicle Emission Budgets (MVEBs) under two different SIPs as an either-or scenario:

- The MVEBs contained in the SIP revision to address the RFP requirements for the HGB moderate ozone nonattainment area for the 2008 8-hr ozone standard ("HGB moderate RFP SIP"). This SIP revision was due to EPA's December 14, 2016 reclassification¹ of

1- [81 FR 90207](#)

the HGB area from “marginal” to “moderate” nonattainment under the 2008 8-hr ozone standard, with a 2017 attainment year. The 2017 MVEBs contained in the HGB moderate RFP SIP revision were found adequate by EPA on June 6, 2017 with an effective date of June 21, 2017.²

- The MVEBs contained in the SIP revision to address the RFP requirements for the HGB serious ozone nonattainment area for the 2008 8-hr ozone standard (“HGB serious RFP SIP”). This SIP revision was due to EPA’s August 13, 2019,³ reclassification of the HGB area from “moderate” to “serious” nonattainment under the 2008 8-hr ozone standard, with a 2020 attainment year. The 2020 MVEBs contained in the HGB serious RFP SIP revision have not yet been found adequate or approved by EPA, but this could occur during the timeframe of this conformity determination, which would result in the 2020 MVEBs being the applicable MVEBs for transportation conformity purposes

This approach to demonstrating conformity is intended to address uncertainty in the timing of EPA’s pending approval of the new HGB serious RFP SIP MVEBs. By demonstrating that the RTP and TIP are able to conform to MVEBs under both the moderate and serious RFP SIPs, we ensure that conformity documentation reflects the applicable MVEBs for transportation conformity purposes as of the date of FHWA’s final approval of this conformity determination.

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 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 to National Ambient Air Quality Standards (NAAQS). Conformity analysis requirements include:

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

² [82 FR 26091](#)

³ [84 FR 44238](#)

Regional Inventory

This conformity analysis developed an air quality regional inventory of the HGB nonattainment area. It accounts for 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

As mentioned previously, due to the timing of this conformity determination and EPA's pending approval of a new RFP SIP for the HGB area, H-GAC will conform to MVEBs under two different SIPs – the HGB moderate RFP SIP and the HGB serious RFP SIP – as an either-or scenario to demonstrate that the RTP and TIP are able to conform to the applicable MVEBs as of the date of FHWA's final approval of this conformity determination. The 2017 budgets established in the HGB moderate RFP SIP are as follows:

HGB Moderate RFP SIP 2017 MVEBs (2008 8-hr ozone standard)

RFP Demonstration Budgets (t/d)		
Year	NOx	VOC
2017	121.81	68.04

Source: HGB moderate RFP SIP, TCEQ, effective June 21, 2017

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

HGB Serious RFP 2020 MVEBs (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 43807, 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 has been re-classified as "serious" for the 2008 8-hr ozone standard, with an attainment year of 2020. However, the associated SIP revision to address the RFP requirements for the HGB serious ozone nonattainment area for the 2008 8-hr ozone standard has not yet been approved by EPA, but it is in the process of being approved.⁴ Due to the potential for these 2020 MVEBs

4- EPA proposed approval of the HGB serious RFP SIP and 2020 MVEBs September 29, 2020 [85 FR 60928](#)

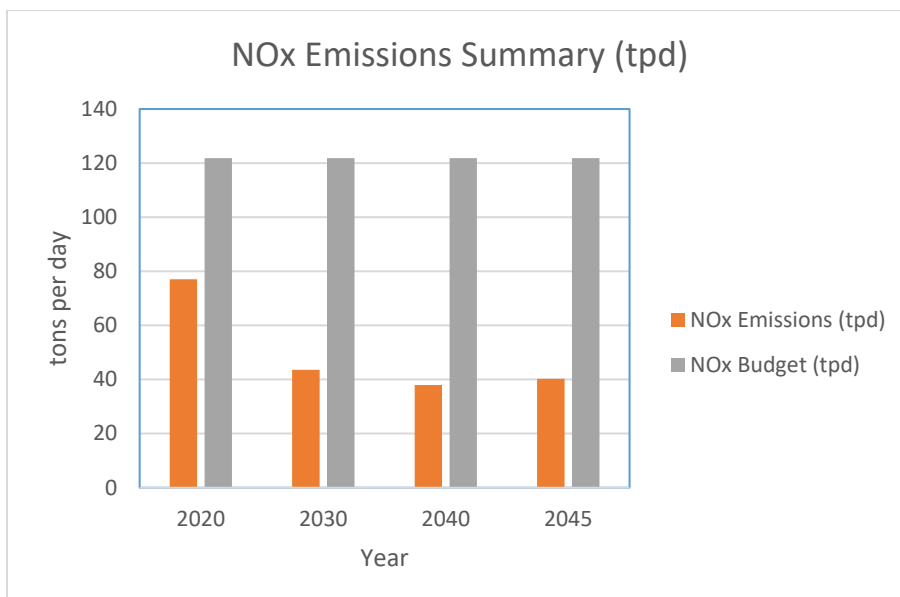
being found adequate and approved during the timeframe of this conformity determination, H-GAC has decided to also use these budgets for the conformity test.

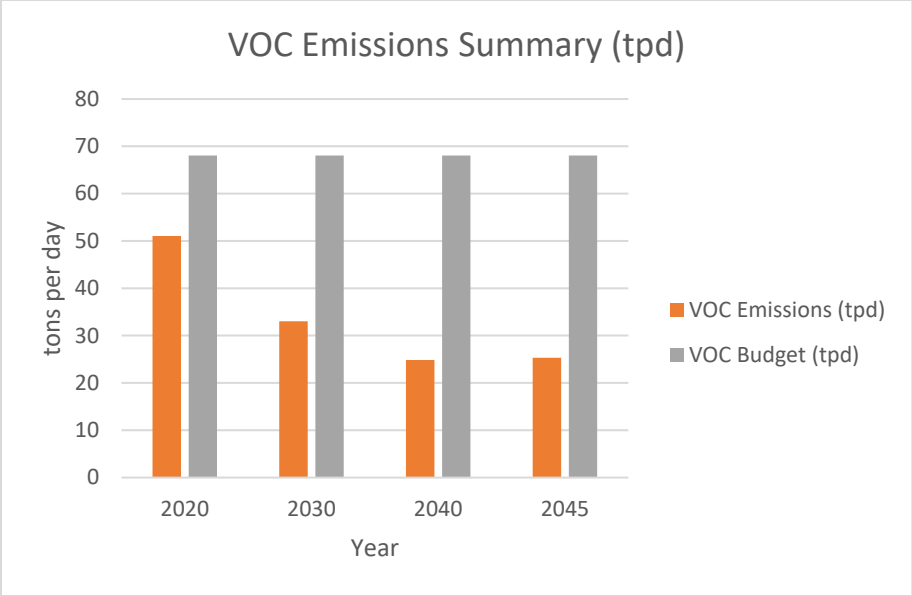
The latest approved MVEBs is the RFP SIP budget coming from the “moderate” reclassification. This MVEB was found adequate by the EPA on June 6, 2017 with an effective date of June 21, 2017. In addition, the HGB region is classified “marginal” for the 2015 8-hr Ozone Standard. Since the “marginal” classification, the HGB region did not get new MVEBs, and therefore, according with the conformity rule, must use previous ones established in the SIP for the 2008 Eight-Hour Ozone Standard.

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

Conformity Analysis Results versus HGB Moderate RFP SIP MVEBs

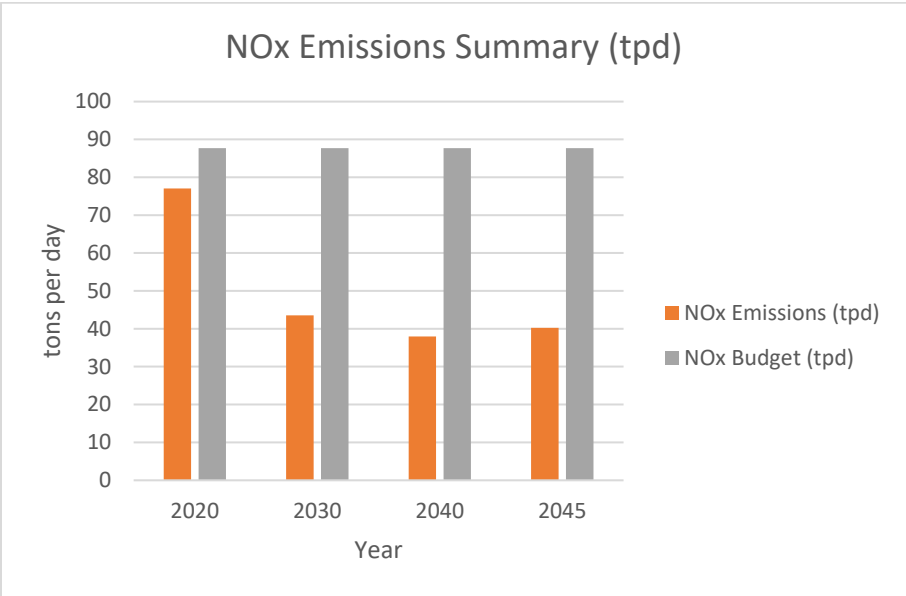
Year	NOx Emissions (tpd)	NOx Budget (tpd)	VOC Emissions (tpd)	VOC Budget (tpd)	VMT
2020	77.03	121.81	51.04	68.04	188,200,352
2030	43.54	121.81	33.01	68.04	228,967,318
2040	37.96	121.81	24.84	68.04	267,995,566
2045	40.25	121.81	25.32	68.04	286,876,227

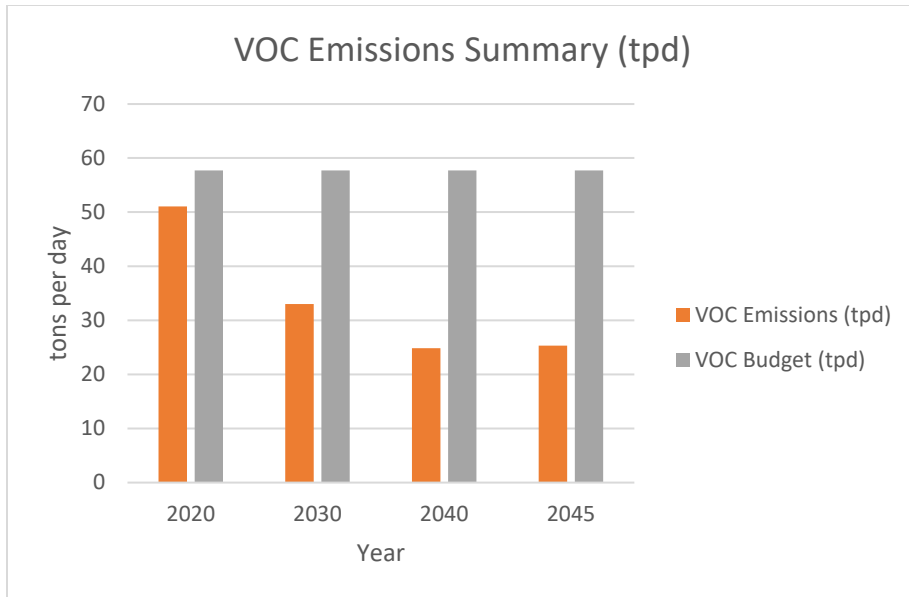




Conformity Analysis Results versus HGB Serious RFP MVEBs

Year	NOx Emissions (tpd)	NOx Budget (tpd)	VOC Emissions (tpd)	VOC Budget (tpd)	VMT
2020	77.03	87.69	51.04	57.70	188,200,352
2030	43.54	87.69	33.01	57.70	228,967,318
2040	37.96	87.69	24.84	57.70	267,995,566
2045	40.25	87.69	25.32	57.70	286,876,227





The results of this conformity determination demonstrate that the amendments to the 2045 RTP and to the 2021-2024 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 14) and a public comment period (Chapter 15).

Chapter 1: INTRODUCTION

1.1 Reasons for Conformity Determination

On August 2, 2019, the Federal Highway Administration (FHWA) and the Federal Transit Administration (FTA) certified that the Houston-Brazoria-Galveston region's *2045 Regional Transportation Plan (RTP)* and the *2019-2022 Transportation Improvement Program (TIP)* met all the requirements for a joint conformity determination to the Air Quality State Implementation Plan (SIP) for the Houston-Galveston-Brazoria (HGB) ozone nonattainment area.

This new conformity determination is being prepared to support the amendments to the 2045 RTP and update to the 2021-2024 TIP. These amendments will increase the total expenditure of the 2045 RTP by approximately \$9 Billion

Major elements of the amendments include:

- a. Construct Express lanes on IH 610 between IH 10 and IH 69
- b. Construct 2-way HOV lanes on IH 10 W between IH 610 west loop and IH 45 N
- c. Construct SH 35 6 lane freeway between Dixie Dr and City of Alvin.
- d. Change the Scope of Hempstead highway (US 290) between IH 610 to Grand Parkway (SH 99)
- e. Reconstruct and widen San Jacinto river bridge on IH 10 E
- f. Reconstruct Houston Ship Channel Bridge on IH 610 E
- g. Reconstruct IH 610 S between SH 35 (Mykawa Rd/SS 5) and SH 288 and IH 610 direct connectors at SH 35 (Mykawa Rd/SS 5)
- h. Widen Grand Parkway (SH 99) by adding Segments E and F.
- i. Reconstruct and Widen Beltway 8 (BW 8) frontage roads between E of Hardy Toll Rd to E of Aldine Westfield Rd
- j. Convert SH 288 to Freeway between future SH 99 to FM 1452
- k. Advance the IH 45 N interchange change at IH 10 W reconstruction and addition of IH 10 express lanes and IH 45 managed lanes part of the North Houston Highway Improvement Project (NHHIP) Segment 3 project to FY 2022.

In accordance with [23 CFR§450.324](#) 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.

Due to the timing of this conformity determination and the U.S. Environmental Protection Agency's (EPA) pending approval of a new Reasonable Further Progress (RFP) SIP for the HGB area, this conformity will demonstrate compliance to Motor Vehicle Emission Budgets (MVEBs) under two different SIPs as an either-or scenario:

- The MVEBs contained in the SIP revision to address the RFP requirements for the HGB moderate ozone nonattainment area for the 2008 8-hr ozone standard ("HGB moderate RFP SIP"). This SIP revision was due to EPA's December 14, 2016 reclassification¹ of

¹- [81 FR 90207](#)

the HGB area from “marginal” to “moderate” nonattainment under the 2008 8-hr ozone standard, with a 2017 attainment year. The 2017 MVEBs contained in the HGB moderate RFP SIP revision were found adequate by EPA on June 6, 2017 with an effective date of June 21, 2017.²

- The MVEBs contained in the SIP revision to address the RFP requirements for the HGB serious ozone nonattainment area for the 2008 8-hr ozone standard (“HGB serious RFP SIP”). This SIP revision was due to EPA’s August 13, 2019,³ reclassification of the HGB area from “moderate” to “serious” nonattainment under the 2008 8-hr ozone standard, with a 2020 attainment year. The 2020 MVEBs contained in the HGB serious RFP SIP revision have not yet been found adequate or approved by EPA, but this could occur during the timeframe of this conformity determination, which would result in the 2020 MVEBs being the applicable MVEBs for transportation conformity purposes

This approach to demonstrating conformity is intended to address uncertainty in the timing of EPA’s pending approval of the new HGB serious RFP SIP MVEBs. By demonstrating that the RTP and TIP are able to conform to MVEBs under both the moderate and serious RFP SIPs, we ensure that conformity documentation reflects the applicable MVEBs for transportation conformity purposes as of the date of FHWA’s final approval of this conformity determination

1.2 Timeline

- March 2020: First conference call with agency partners/TAC and TPC announcement.
- October 2020: Review for model networks and Pre-Analysis Consensus document.
- December 2020: Travel demand model runs.
- January 2020: Air quality model runs.
- March 2021: TAC and TPC preview.
- March 2021: Public comment period from March 26 to April 28
- April 2021: Virtual public meetings – April 8th, 2pm and 6 pm
- May 2021: TAC and TPC recommends approval of conformity determination and RTP and TIP amendments
- Receive Federal Approval – 3 months later.

² [82 FR 26091](#)

³ [84 FR 44238](#)

Chapter 2: AIR QUALITY CONFORMITY

2.1 What is Transportation Conformity?

Transportation conformity is the process that links the Air Quality State Implementation Plan (SIP) with regional roadway planning, which occurs in the Regional Transportation Plan (RTP) and the Transportation Improvement Program (TIP). Conformity is demonstrated when projected regional air quality emissions from the transportation plan do not exceed the region's motor vehicle emissions budgets (MVEB) 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.

2.2 Conformity Requirements

The Clean Air Act Amendments of 1990 (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 National Ambient Air Quality Standards (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 Checklist

Table 2.1: Conformity Checklist

INFORMATION REQUIRED FOR TRANSPORTATION CONFORMITY REVIEW			
ITEM	REGULATION REFERENCE	FORMAT	REPORT LOCATION
Documents			
2045 Metropolitan Transportation Plan (MTP)	40 CFR 93 Subpart A	Independent Self-Supporting Document	http://www.h-gac.com/taq/plan/2045/default.aspx
2019-2022 Transportation Improvement Program (TIP)	40 CFR 93 Subpart A	Independent Self-Supporting Document	http://www.h-gac.com/taq/tip/2019-2022-tip.aspx
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
MOVES Input Parameters		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 pre-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	http://www.h-gac.com/taq/air_quality_model/conformity/acronyms.aspx
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.

2.4 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.

2.4.1 Regional Inventory

This conformity analysis develops an air quality regional inventory of the HGB nonattainment area. It accounts for 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.

2.4.2 Emissions Tests

The Houston-Galveston-Brazoria (HGB) region is in non-attainment for the 8-hr Ozone Standard and therefore the Air Quality SIP must regulate the Ozone precursors, which are nitrogen oxides (NOx) and volatile organic compounds (VOC’s). As specified by the Code of Federal Regulations (40 CFR 93.109[c], as amended by 62 FR 43807, Aug. 15, 1997) all ozone nonattainment areas designated moderate and above must pass a MVEB test if an approved SIP budget exists.

As mentioned previously, due to the timing of this conformity determination and EPA’s pending approval of a new RFP SIP for the HGB area, H-GAC will conform to MVEBs under two different SIPs – the HGB moderate RFP SIP and the HGB serious RFP SIP – as an either-or scenario to demonstrate that the RTP and TIP are able to conform to the applicable MVEBs as of the date of FHWA’s final approval of this conformity determination

In addition, the HGB region is classified “marginal” for the 2015 8-hr Ozone Standard. Since the “marginal” classification, the HGB region did not get new MVEBs, and therefore, according with the conformity rule, must use previous ones established in the SIP for the *2008 Eight-Hour Ozone Standard*.

Specifically, the budget test is satisfied when ozone precursor (VOC and NOx) 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 2017 budgets established in the HGB moderate RFP SIP are as follows:

Table 2.2: HGB Moderate RFP SIP 2017 MVEBs (2008 8-hr ozone standard)

RFP Demonstration Budgets (t/d)		
Year	NOx	VOC
2017	121.81	68.04

Source: RFP SIP, TCEQ, effective June 21, 2017

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

Table 2.3: HGB Serious RFP 2020 MVEBs (2008 8-hr 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 emission inventories and the analysis conducted for the development of the RFP SIP and include emission reduction benefits from federal and state control programs.

2.4.3 Analysis Years

For the emission budget test, according to the conformity rule (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 2.4: Conformity Analysis Years

Requirement	Years
Conformity Base Year (validation year)	2016
Attainment Year	2020 ¹
Motor Vehicle Emissions Budget Years	
First Analysis Year	2020
Intermediate Analysis Years	2030, 2040
Last Year of RTP	2045

¹Attainment year 2020 for the 2015 8-hr Ozone Standard and for the 2008 8-hr 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) is anticipated to consider the amendment to the 2021-2024 Transportation Improvement Program (TIP) for approval on May 28, 2021

The 2045 RTP covers a planning period of 2019 through 2045 and contains a list of projects fiscally constrained by estimates of reasonably available revenues. The complete 2045 RTP is available online at <http://2045rtp.com/default.aspx>.

The 2045 RTP 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 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, Regional Transportation Plan 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 utilizes a financial model and works with TxDOT, regional public transportation operators, and stakeholder agencies to develop estimates of future expenditures and

revenues for the transportation plan. The amended 2045 RTP's total expenditure is estimated to be approximately \$141 billion. The 2045 RTP estimates \$147 billion of revenues reasonably available for recommended improvements.

3.2 Transportation Improvement Program

3.2.1 Overview

H-GAC's TPC is anticipated to consider the amendment to the 2021-2024 Transportation Improvement Program (TIP) for approval on May 28, 2021. This TIP covers a planning period of 2021 through 2024 and contains a list of projects fiscally constrained by funding commitments and estimates of reasonably available revenues. The original adopted TIP and subsequent amendments are available online at <http://h-gac.com/taq/tip>.

The current 2021-2024 TIP is amended to reflect the changes to fiscally constrained regionally significant projects. A complete listing of projects, as proposed under this conformity determination, is provided in 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.

3.2.2 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 their 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 2021 – 2024 TIP outlines the financial plan utilized to implement the projects programmed through the 2021-2024 TIP.

3.3 Regionally Significant Travel Projects/Programs

Projects determined to be regionally significant, except as specifically exempted under 40 CFR 93.126 and 40 CFR 93.127, 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-exempt¹ 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

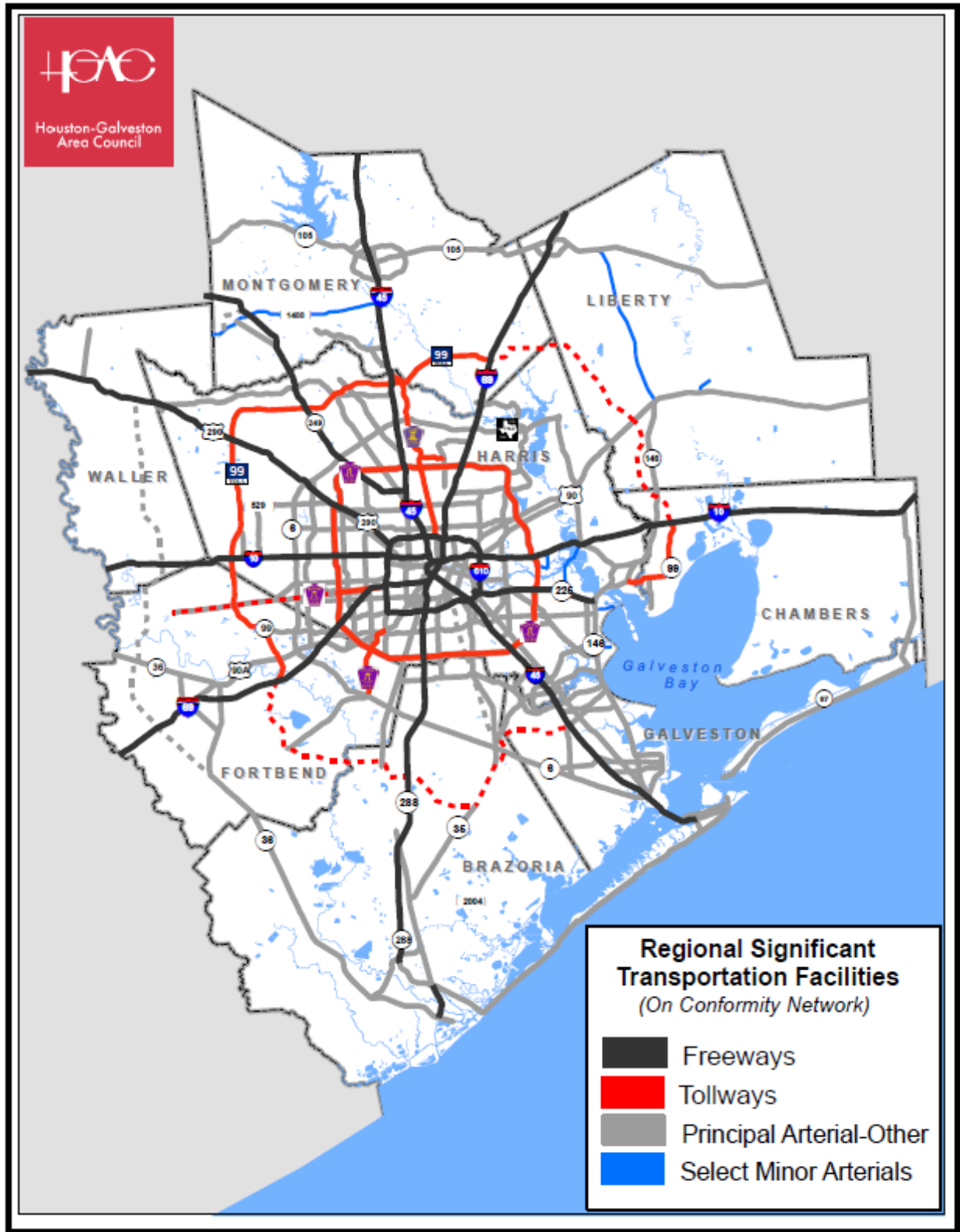
Any transit facility within an exclusive right-of-way (“fixed guideway”) that offers an alternative to regional highway travel including light rail, commuter rail, bus rapid transit, and barrier separated High Occupancy Vehicles (HOV) lanes shall be considered regionally significant.

Other Projects

The regional significance of non-exempt projects¹ 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, of the final conformity rule, exempts traffic signal synchronization projects; however, regionally significant traffic signal synchronization projects must include in subsequent regional emissions analyses.

Chapter 4: ESTIMATION OF VEHICLE ACTIVITY

4.1 Travel Model Overview

The previous 2040 RTP conformity analyses (executed in years 2015 and 2016) and this conformity analysis (executed in year 2017) 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 to be added or removed by amendments to the RTP 2045. In addition, the transit routes were updated to include transit service changes made by various transit agencies since the last conformity, as well as the METRO Next transit plan.

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:

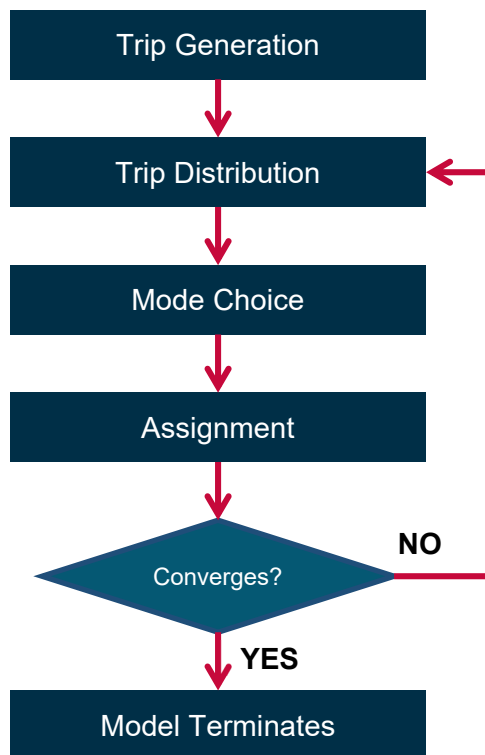


Figure 4.1: Traditional 4-Step Model General Procedure

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 2012; (hereinafter referred to as the 2012 model). The roadway assignment is validated using the year 2012 annual traffic counts collected by the Texas Department of Transportation.

Brief descriptions of the 2012 model components are provided in section 4.2. Further, details of the 2012 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 eight-county Houston-Galveston-Brazoria Consolidated Metropolitan Statistical Area (CMSA) has been federally designated as the Transportation Management Area (TMA) for the Houston-Galveston region. The Houston-Galveston TMA counties are Harris County, 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 Forecast¹ can be found on H-GAC's web site <http://www.h-gac.com/community/socioeconomic/2040-regional-growth-forecast/default.aspx>

¹ H-GAC, 2016. "H-GAC's Regional Growth Forecast." H-GAC, 2016, Website: <http://www.h-gac.com/community/socioeconomic/2040-regional-growth-forecast/default.aspx>

The socio-demographic forecast has been updated since the 2016 conformity was completed. The 2015 second quarter H-GAC Regional Growth Forecast was used for the 2016 conformity, and the year 2016 forecast release was used for this 2017 conformity. Table 4.1 summarizes the year 2045 forecast number of households by county (which excludes group quarters such as prisons and dormitories) for the year 2015 and 2016 socio-demographic forecasts. The total number of persons and households remain the same for both versions of the socio-demographic forecast, but the spatial distribution of these demographics have changed. The year 2016 release is more optimistic for households moving into Waller County.

Table 4.1: County Households for 2000 and 2016

County	Year 2010	Year 2016	Change	% Change
Brazoria	81,954	127,952	45,998	56.13%
Chambers	9,139	13,452	4,313	47.19%
Fort Bend	110,915	258,521	147,606	133.08%
Galveston	94,782	121,785	27,003	28.49%
Harris	1,205,516	1,619,688	414,172	34.36%
Liberty	23,242	29,134	5,892	25.35%
Montgomery	103,297	208,612	105,315	101.95%
Waller	10,557	18,778	8,221	77.87%
Region Total	1,639,402	2,397,922	758,520	46.27%

A comparison of the year 2000 and year 2016 employment for the eight-county region, as presented in Table 4.2, shows that employment increased comparably with population growth, 48.76% percent overall. Harris County gained over 707,447 jobs while Montgomery County employment grew more than 150.57% percent (over 127,563 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 2040 County Employment from H-GAC's Regional Growth Forecast

County	Year 2000	Year 2016	Change	% Change
Brazoria	75,556	117,472	41,916	55.48%
Chambers	7,759	17,430	9,671	124.64%
Fort Bend	96,316	214,742	118,426	122.96%
Galveston	86,469	130,118	4,3649	50.48%
Harris	1,802,351	2,509,798	707,447	39.25%
Liberty	15,484	18,045	2,561	16.54%
Montgomery	84,719	212,282	127,563	150.57%
Waller	9,611	20,434	10,823	112.61%
Region Total	2,178,265	3,240,321	1,062,056	48.76%

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.

External travel

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.

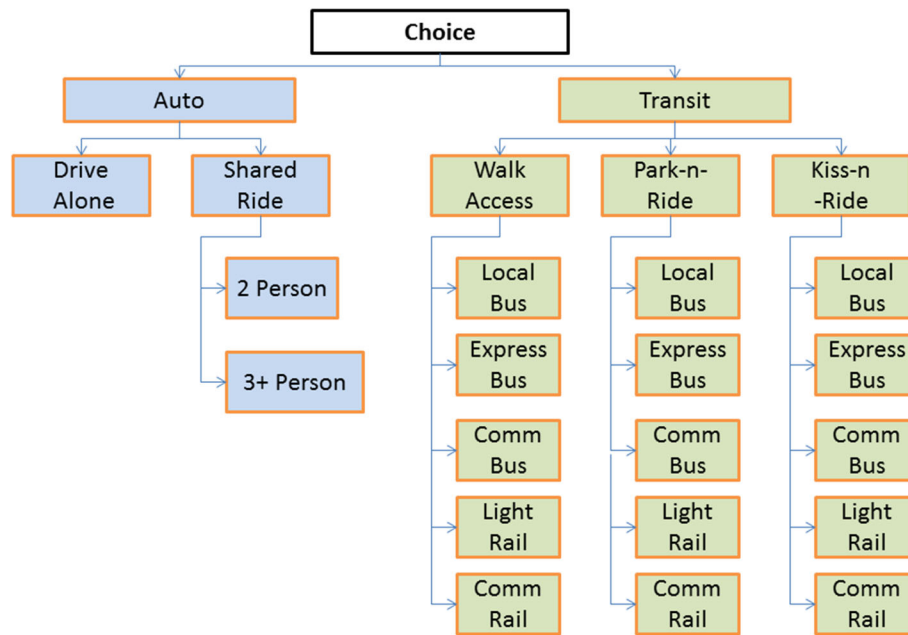


Figure 4.2: Mode Choice Model Structure

4.2.4 Assignment Model

Time-of-Day Model

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.

Assignment Methodology

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	2012
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 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:

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

$$VC2(A, B) = VOL2(A, B) / (CAP24ndir(A, B) \times CAPFAC(AT, FC) \times 0.5)$$

$$SPD0(A, B) = SPD24 \times SPD0FAC(AT, FC)$$

$$SPD1(A, B) = SPD24 \times SPD1FAC(AT, FC)$$

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 non-directional 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:

$$VC1(A, B) = VOL1(A, B) / (CAP24dir(A,B) \times CAPFAC(AT,FC))$$

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 to 1.0) 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) 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 eight-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 Texas A&M Transportation Institute 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)
 = 172,203,352

A – Provided by Dennis Perkinson, TTI, August 2017

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)
 = (172,203,352) / (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 2009-2018. These factors, provided in Table 6a, 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, Ft. 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	1.01278
	Liberty, Chambers	0.98786

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

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

Table 4.6: Hourly Factors*

Hours	Designations
12:00 a.m. – 12:59 a.m.	0.009121
1:00 a.m. – 1:59 a.m.	0.006019
2:00 a.m. – 2:59 a.m.	0.005611
3:00 a.m. – 3:59 a.m.	0.006053
4:00 a.m. – 4:59 a.m.	0.012773
5:00 a.m. – 5:59 a.m.	0.036885
6:00 a.m. – 6:59 a.m.	0.062319
7:00 a.m. – 7:59 a.m.	0.067438
8:00 a.m. – 8:59 a.m.	0.057704
9:00 a.m. – 9:59 a.m.	0.051828
10:00 a.m. – 10:59 a.m.	0.050526
11:00 a.m. – 11:59 a.m.	0.052335
12:00 p.m. – 12:59 p.m.	0.054198
1:00 p.m. – 1:59 p.m.	0.054198
2:00 p.m. – 2:59 p.m.	0.057660

Hours	Designations
3:00 p.m. – 3:59 p.m.	0.063116
4:00 p.m. – 4:59 p.m.	0.067657
5:00 p.m. – 5:59 p.m.	0.070612
6:00 p.m. – 6:59 p.m.	0.059130
7:00 p.m. – 7:59 p.m.	0.046077
8:00 p.m. – 8:59 p.m.	0.035841
9:00 p.m. – 9:59 p.m.	0.031218
10:00 p.m. – 10:59 p.m.	0.024405
11:00 p.m. – 11:59 p.m.	0.016531

Source: *Data from Texas A&M Transportation Institute – Hourly factors calculated using 2009-2018 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. Highway/Transit Networks & Related Data H-GAC Regional Travel Demand Models 3-7 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
2017	8,936	27,700
2020	8,959	27,994
2021	9,077	28,058
2025	9,263	30,216
2035	9,405	31,069
2040	9,405	31,081

Chapter 5: ESTIMATION OF OFF-NETWORK ACTIVITY

The off-network activity is calculated using inputs from two Texas Transportation Institute's (TTI) modules. The MOVESpopulationBuild module is used to convert Texas Department of Motor Vehicles registration data for each county into 13 MOVES2014 source use type (SUT) population (or vehicle population). The county-level Source Hour Park (SHP), starts, Source Hour Idling (SHI), and APU hours of off-network activity were developed using the "OffNetActCalc" utility and methodology provided by TAMU TTI¹.

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

5.1 Estimation of Source Hours Parked

The first activity measure needed to estimate the off-network emissions using the mass per activity emissions rates are county-level analysis year weekday estimates of SHP by hour and vehicle type. For each hour, the county-level vehicle type SHP was calculated by taking the difference between the vehicle type total available hours minus the vehicle type vehicle hours traveled (VHT). Since this calculation was performed at the hourly level, the vehicle type total available hours was set equal to the vehicle type population. The Source Hours Operating (SHO) was calculated using the link vehicle miles of travel (VMT) and speeds and the VMT mixes by MOVES road-type category.

Calculation of the off-network evaporative emissions is complicated slightly by the fact that MOVES does not generate rate per activity outputs for evaporative emissions. Instead, it reports rates per vehicle in the ratePerVehicle (fuel leaks and permeation) and ratePerProfile (fuel vapor venting) tables. Therefore, an intermediate step is required to convert these rates per vehicle data into rate per activity. For evaporative emissions, activity is in terms of source hours parked (SHP). Rate per SHP can be derived from rate per vehicle as follows:

$$\text{RatePerSHP} = \text{RatePerVehicle} \times (\text{vehicles/SHP})$$

where,

vehicles = is the vehicle population for a given hour, source type, and fuel type, and
SHP = is the corresponding source hours parked for these vehicles. These activity data come from the County Scale Inventory Mode MOVES runs, and the emission rates come from the County Scale Rate Mode runs.

¹ TTI Emission Inventory Estimation Utilities Using MOVES: MOVES2014aUtil User's Guide, August 2016.5.1.1 *Vehicle Type Total Available Hours*

5.1.1 Vehicle Type Vehicle Hours Travelled

To calculate the VHT for a given link, the VMT was allocated to each vehicle type using the Texas Department of Transportation district-level vehicle type VMT mixes by MOVES road-type category, which was then divided by the link speed to calculate the link vehicle type VHT. These VMT mixes are the same VMT mixes used to estimate emissions in the emissions estimation process. This SHO calculation was performed for each link in each hour, aggregating the VHT to one value per vehicle type per hour.

5.2 Estimation of Starts

The second activity measure needed to estimate the off-network emissions using the mass per activity emissions rates are county-level analysis year weekday estimates of starts by hour and vehicle type. The vehicle type hourly default starts per vehicle were multiplied by the analysis year county-level vehicle type vehicle population to estimate the county-level vehicle type starts by hour. Appendix 19 includes the 24-hour summaries of the county-level vehicle type starts by hour for each analysis year.

For the hourly default starts per vehicle, the MOVES defaults were used. The MOVES activity output was used to estimate the hourly starts per vehicle for a MOVES weekday run by dividing the MOVES start output by the MOVES vehicle population output. These MOVES national default starts per vehicle do not vary by year, only by MOVES day type. For this weekday analysis, the MOVES national default “weekday” starts per vehicle were used.

5.3 Estimation of Source Hours Idling and Auxiliary Power Unit Hours

The remaining activity measures needed to estimate the off-network emissions using the mass per activity emissions rates are the hourly, county-level analysis year weekday heavy-duty diesel truck (SUT 62, fuel type 2 [CLhT_Diesel]) SHI and APU hours (hoteling activity). During hoteling, the truck’s main engine is assumed to be in idling mode or its APU is in use. To calculate the SHI and APU hours activity, the hoteling hours activity were calculated, which was then allocated to the SHI and APU hours components.

The hoteling activity was based on information from a TCEQ extended idling study, which produced 2017 weekday extended idling estimates for each Texas County and hoteling activity data from MOVES. Hoteling scaling factors (by analysis year) were applied to the base 2017 weekday hoteling values from the study to estimate the 24-hour hoteling by analysis year. Hoteling hourly factors were then applied to allocate the 24 -hour hoteling by analysis year to each hour of the day. To ensure that valid hourly hoteling values are used, the hourly hoteling activity was compared to the CLhT_Diesel hourly SHP (i.e., hourly hoteling values cannot exceed the hourly SHP values). SHI and APU hours factors were then applied to the hoteling hours to produce the hourly SHI and APU hours of activity.

5.3.1 Hoteling Activity Scaling Factors

To estimate the analysis year county-level 24-hour hoteling activity, county-level hoteling activity scaling factors were developed using the county-level 2017 weekday link-level VMT and speeds, the VMT mix (by MOVES road type), the county-level analysis year weekday link-level VMT and speeds, and the VMT mix (by MOVES road type). The 2017 weekday link-level VMT and speeds

were developed using a process similar to the 2020, 2030, 2040 and 2045 weekday link-level VMT speed estimation. The vehicle type VMT mixes were the same VMT mixes used to estimate emissions in the emissions estimation process. For the base weekday vehicle type VMT mix, the 2015 weekday vehicle type VMT mix was used. For each link in the 2017 weekday link-level VMT and speeds, the link VMT was allocated to CLhT_Diesel using the base weekday vehicle type VMT mix. This VMT allocation was performed for each link and hour in the 2017 weekday link-level VMT and speeds, with the individual link VMT aggregated by hour to produce the CLhT_Diesel hourly and 24 -hour 2017 weekday VMT. Using a similar allocation process, the analysis year weekday CLhT_Diesel hourly and 24-hour VMT was calculated using the analysis year weekday link-level VMT and speeds and the analysis year vehicle type VMT mix. The county-level 24-hour hoteling activity scaling factors by analysis year were calculated by dividing the analysis year and day type CLhT_Diesel 24 -hour VMT by the CLhT_Diesel 24-hour 2017 weekday VMT.

5.3.2 Hoteling Activity Hourly Factors

. To allocate the analysis year weekday county-level 24-hour hoteling activity to each hour of the day, hoteling activity hourly factors were used. These hoteling activity hourly factors were calculated as the inverse of the analysis year weekday CLhT_Diesel hourly VMT fractions. The analysis year weekday CLhT_Diesel hourly VMT fractions were calculated using the hourly analysis year weekday CLhT_Diesel VMT. The hourly analysis year weekday CLhT_Diesel VMT was converted to hourly fractions, therefore creating analysis year weekday CLhT_Diesel hourly VMT fractions. The inverse of these hourly VMT fractions were calculated and the inverse for each hour was divided by the sum of the inverse hourly VMT fractions across all hours to calculate the county-level analysis year weekday hoteling activity hourly factors for each analysis year.

5.3.3 County Level Fuel Type 2 (CLhT_Diesel) Hoteling Activity by Hour Estimation

The four analysis years' weekday CLhT_Diesel hoteling activity by hour was calculated by multiplying the 24-hour 2017 weekday hoteling hours by the analysis year hoteling activity scaling factor and by the analysis year hoteling activity hourly factors. For each hour, the analysis year weekday hoteling activity was then compared to the analysis year weekday CLhT_Diesel SHP to estimate the final analysis year weekday hoteling activity by hour. If the analysis year weekday hoteling activity value was greater than the analysis year weekday SHP value, then the final analysis year weekday hoteling activity for that hour was set to the analysis year weekday CLhT_Diesel SHP value. Otherwise, the final analysis year weekday hoteling activity for that hour was set to the base analysis year weekday hoteling activity value. All calculations (scaling factors, hoteling activity hourly factors, and hoteling activity by hour calculations) were performed by county and analysis year (i.e., eight hoteling activity scaling factors were calculated per analysis year).

5.3.4 County-Level Fuel Type 2 (CLhT_Diesel) Source Hours Idling and Auxiliary Power Unit Hours Estimation

Weekday hourly county-level hoteling activity for all analysis years was then allocated to SHI and APU hours activity components using the aggregate extended idle mode and APU mode fractions. For each hour, the analysis year weekday hoteling activity was multiplied by the SHI fraction to

calculate the analysis year weekday hourly SHI activity and by the APU fraction to calculate the analysis year weekday hourly APU activity. The aggregate SHI and the APU fractions were estimated using model year travel fractions (based on source type age distribution and relative mileage accumulation rates used in the MOVES runs) and the MOVES default hoteling activity distribution (i.e., a bi-modal distribution of 1.0 SHI prior to the 2010 model year and a 0.7/0.3 SHI/APU activity allocation for 2010 and later model years). The associated travel fractions were applied to the appropriate extended idle and APU operating mode fractions (of the hoteling operating mode distribution) by model year and summed within each mode to estimate the aggregate (across model years) individual SHI and APU fractions (which sum to 1.0)

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, including emission “hot-spots” not on the traditional travel network, such as truck stops and port terminals. This framework employs the latest version of the U.S. EPA MOBILE model, MOVES2014b¹, 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 stars) 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.

$$\text{Vehicle Emissions} = \text{Vehicle Activity} \times \text{Emission Rate}$$

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 MOVES2014b. 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.

A full list of MOVES2014b input parameters can be found in Appendix 7. These parameters include the Texas Department of Motor Vehicle Registration, fuel supply, fuel formulation, 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. New data includes updated fuel formulation, Texas Low Emission Diesel Adjustments (TxLED) and new vehicle registration data. It should also be noted that there is no I/M program in the rural counties. Appendix 7 presents all data inputs, including local meteorological data, state control programs, federal control programs, and vehicle fleet characteristics.

¹ <https://www.epa.gov/moves/latest-version-motor-vehicle-emission-simulator-moves>

6.3 Adjustments to Emission Factors

The nitrogen oxides (NO_x) emission factors calculated by MOVES need to be adjusted due to the use of TxLED in Texas, which produces lower NO_x emissions than the national low emission diesel fuel. The adjustment factors were developed by TCEQ using the latest available data (i.e., state-wide age distributions based on the latest available end-of-year 2018 TxDMV vehicle registrations) and MOVES2014a (November 2016 update). 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	2020 Factor	2030 Factor	2040 Factor	2045 Factor
Passenger Car	0.9506	0.9516	0.952	0.952
Passenger Truck	0.9492	0.9514	0.952	0.952
Light Commercial Truck	0.9467	0.9504	0.952	0.952
Intercity Bus	0.9438	0.9492	0.952	0.952
Transit Bus	0.9444	0.9497	0.952	0.952
School Bus	0.9439	0.9498	0.952	0.952
Refuse Truck	0.9469	0.9518	0.952	0.952
Single Unit Short-Haul Truck	0.9511	0.9519	0.952	0.952
Single Unit Long-Haul Truck	0.9510	0.9519	0.952	0.952
Motor Home	0.9472	0.9510	0.952	0.952
Combination Short-Haul Truck	0.9491	0.9518	0.952	0.952
Combination Long-Haul Truck	0.9490	0.9518	0.952	0.952

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, TTI, and the Houston region travel demand model.

TTI developed these weekday VMT mixes using new Vehicle Command Count (VCC) data (2009 through 2018) and new TxDMV vehicle registration data (2018 end-of-year data) and the same method/procedures as used on Texas A&M Transportation Institute'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 eight-county HGB area (i.e., Houston and Beaumont districts). The VMT mixes were developed for the years 2020, 2030, 2040 and 2045.

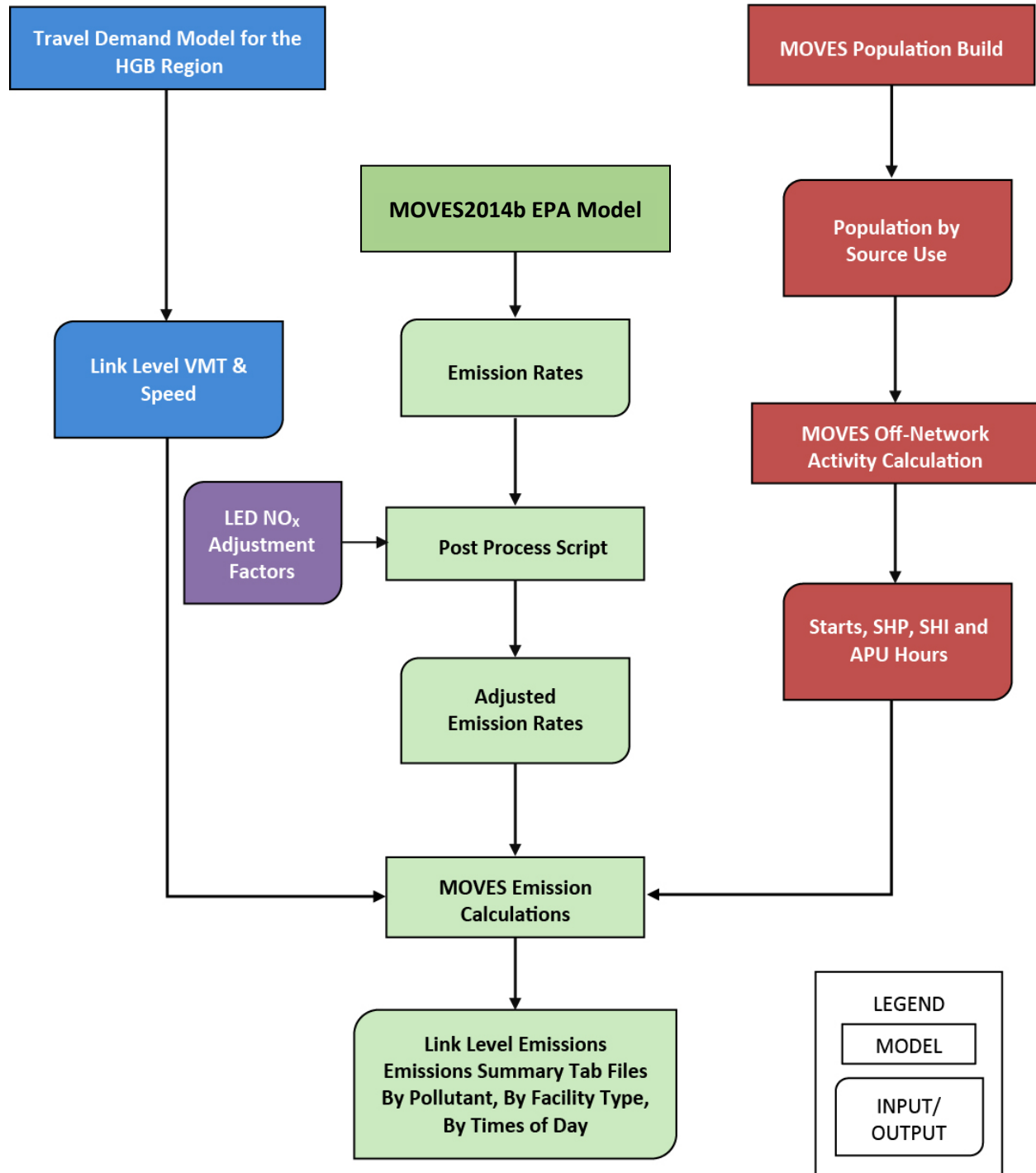
This data will be included in Appendix 9 of final conformity report.

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



6.5 Modeled Emissions Analysis Results

The tables below show the final modeled emission results.

Table 6.2: Conformity Analysis Results versus HGB Moderate RFP SIP MVEBs

Year	NOx Emissions (tpd)	NOx Budget (tpd)	VOC Emissions (tpd)	VOC Budget (tpd)	VMT
2020	77.03	121.81	51.04	68.04	188,200,352
2030	43.54	121.81	33.01	68.04	228,967,318
2040	37.96	121.81	24.84	68.04	267,995,566
2045	40.25	121.81	25.32	68.04	286,876,227

Table 6.3: Conformity Analysis Results versus HGB Serious RFP MVEBs

Year	NOx Emissions (tpd)	NOx Budget (tpd)	VOC Emissions (tpd)	VOC Budget (tpd)	VMT
2020	77.03	87.69	51.04	57.70	188,200,352
2030	43.54	87.69	33.01	57.70	228,967,318
2040	37.96	87.69	24.84	57.70	267,995,566
2045	40.25	87.69	25.32	57.70	286,876,227

Chapter 7: MOBILE SOURCE EMISSION REDUCTION STRATEGIES

7.1 Transportation Control Measures

A Transportation Control Measure (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, 43803. 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 Transportation Control Measures.

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 Final Emissions Analysis Results

Since this conformity does not use credits from voluntary mobile emission reduction programs or TCMs, the final emissions results are the same as the modeled emissions results. As mentioned previously, due to the timing of this conformity determination and EPA's pending approval of a new RFP SIP for the HGB area, H-GAC will conform to MVEBs under two different SIPs – the HGB moderate RFP SIP and the HGB serious RFP SIP – as an either-or scenario to demonstrate that the RTP and TIP are able to conform to the applicable MVEBs as of the date of FHWA's final approval of this conformity determination. The tables below show the final emission results for this conformity using both MVEBs.

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

Year	NOx Emissions (tpd)	NOx Budget (tpd)	VOC Emissions (tpd)	VOC Budget (tpd)	VMT
2020	77.03	121.81	51.04	68.04	188,200,352
2030	43.54	121.81	33.01	68.04	228,967,318
2040	37.96	121.81	24.84	68.04	267,995,566
2045	40.25	121.81	25.32	68.04	286,876,227

Table 7.3: Final Emission Results versus HGB Serious RFP SIP MVEBs

Year	NOx Emissions (tpd)	NOx Budget (tpd)	VOC Emissions (tpd)	VOC Budget (tpd)	VMT
2020	77.03	87.69	51.04	57.70	188,200,352
2030	43.54	87.69	33.01	57.70	228,967,318
2040	37.96	87.69	24.84	57.70	267,995,566
2045	40.25	87.69	25.32	57.70	286,876,227

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**, Part 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 part of the conformity process. A 30-day public comment period is required by Federal regulations. All documentation for this conformity will be distributed to the consultation committee by posted it on H-GAC's website <http://h-gac.com/transportation-conformity/2021-conformity.aspx> on March 26, 2021. This website will be further utilized to post draft conformity material as it is developed by H-GAC and reviewed by the consultation partners.

The Public comment period begins on Friday, March 26, 2021 and ends on April 28 2021 at 5:00pm. Two public virtual meetings will be held on Thursday, April 8, 2021, at 2pm and 6 pm. Comments received will be responded to in Appendix 15. The minutes from the public hearing can also be found in the same appendix.