Scenario Planning of Future Freight and Passenger Traffic Flows Across the US/Mexico and US/Canada Borders

Final Report/White Paper

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16. Abstract

FHWA, in cooperation with Transport Canada and the Mexican Secretariat of Transportation and Communications, developed U.S.-Canada and U.S.-Mexico projections of future freight and passenger volumes over the next 30 years (2015 – 2045) from a North American framework and a regional border perspective. The study developed national macro-level data projections between the U.S. and Canada and the U.S. and Mexico borders and regional micro-level data projections along and within the border regions of the U.S. The planning scenarios and data projections are displayed in a visualization tool compatible with the FHWA Office of Planning, Environment, and Realty GIS Planning Tool (HEPGIS).

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1. EXECUTIVE SUMMARY

1.1 BACKGROUND OF THE STUDY

This report, **Scenario Planning of Future Freight and Passenger Traffic Flows Across the United States-Mexico and United States-Canada Borders,** provides stakeholders in the United States, Canada, and Mexico with a common set of scenario-based, binational traffic forecasts for use in planning. These new scenarios build upon current research on long-term scenario planning for freight and passenger flows.

The project was developed through direct consultation with the Governments of Mexico and Canada through the United States-Mexico Joint Working Committee for Transportation (JWC), the United States-Canada Transportation Border Working Group (TBWG), and the North American Transportation Statistical (NATS) Interchange, as well as through other bilateral and trilateral consultations with key stakeholders.

The scenario development process leveraged research conducted by the Massachusetts Institute of Technology (MIT) in 2013 and published in the *National Corporate Highway Report Project (NCHRP) 750, Volume 1*, under the title “Scenario Planning for Freight Transportation Infrastructure Investment.” *NCHRP 750* applied scenario planning for freight, capturing potential economic and social changes, as well as sourcing patterns that would affect freight and passenger traffic.

This report uses four potential future scenarios, each of which produces different demands on the system. Each of these four scenarios was discussed with U.S. Department of Transportation (USDOT) partners in Canada and Mexico to establish its use for the project with or without modification. Furthermore, each scenario was validated by stakeholders in terms of its applicability to recent post-recession trends and changes.

Used as a baseline for freight elements of the scenario planning, the multimodal freight traffic forecasts in the Freight Analysis Framework (FAF) provided the modal volume and commodity detail for binational flows in and out of the United States. The forecasts in the FAF were extended to 2045, with linear regressions of analyses of historic border crossing data and socioeconomic data – such as population, employment, and currency exchange rates – used to estimate future passenger crossings. The passenger and freight flows in the scenarios included details for each crossing location, as well as details for traffic along and within the border regions. Importantly, for the scenario analyses, the underlying economic and demographic indicators behind the commodity flow forecasts were adjusted to reflect unique conditions for each of the scenarios developed in the project.

The forecasting models used in the scenario simulations relied on regional, industrial, and commodity trade, as well as demographic details, to accurately reflect the characters of the developed scenarios.

The scenario planning results were distributed to broad audiences of executives and planners in the three countries. An interactive visualization system was also developed as part of the project. The system allows users to observe the changes in freight and passenger traffic, populations, and industry sectors by border region; visualize passenger and freight movement in North America and at United

States-Canada and United States-Mexico border crossings; and compare results by scenario and under various traffic, population, and industry trends.

1.2 STUDY OBJECTIVES

This study developed regional and national projections of future freight and passenger corridor volumes from a regional, bi-national border perspective and a North American framework of future flows over the next 30 years. Specifically, the study produced:

- A North American multi-modal transportation flow framework that builds upon existing and ongoing research in the United States, Canada, and Mexico.
- A common understanding and consensus between and within Canadian, Mexican, and United States agencies regarding a range of future scenarios that might impact freight and passenger traffic flows across the United States-Mexico and United States-Canada borders through the year 2045 by using scenario planning methodology.
- Common sets of binational population, business, and traffic data projections that are well documented and accessible to all agencies for their respective planning efforts.
- Detailed micro-level population, business, passenger, and freight flow projections along and within the border regions of the United States and at each crossing.
- National macro-level regional multi-modal freight and passenger traffic flow, population, and industry projections between each country.
- A visualization system to display the proposed scenarios in a manner compatible with the Office of Planning, Environment, and Realty GIS Planning Tool (HEPGIS).

1.3 THE BENEFITS OF SCENARIO PLANNING FOR TRANSPORTATION DECISION-MAKERS

Scenario planning is a process that evaluates future possible effects of alternative policies, plans, and/or programs on a community or region. This activity provides important information to federal, state, regional, and local decision-makers in the development of transportation plans, as stakeholders may use scenarios to explore and debate alternatives and trade-offs. By testing scenarios against performance indicators, decision-makers can select a preferred scenario and identify the appropriate actions to realize that vision.

Recent history has demonstrated that the traditional approach of first generating predictions as a continuation of current or historical trends and then planning accordingly does not accommodate the uncertainty of events that may occur. Organizations have realized this flaw in the traditional planning approach and are now adopting the scenario planning approach, which focuses on preparing for multiple plausible futures instead of precisely predicting one.

As illustrated in **Figure E-1**, the traditional planning approach looks at a "point forecast," or a model that that starts in the present and extends to a certain point in the future. This approach is generally based on the future assumed values of present trends and does not consider additional combinations of factors.

The second level of planning, which is somewhat improved from the point forecast approach, is risk analysis, which entails examining a range of results through varying analytical inputs by a certain percentage. Like the traditional point forecast approach, the starting point of a risk analysis is the present day, rather than the future or "planning horizon" for which the plans are prepared.

Scenario planning, in contrast, begins with several plausible future conditions called Scenarios (described as Future 1, Future 2 and Future 3 in **Figure E-1**), and then moves backward in time, ultimately using present-day data for a scenario analysis. The arrows point from the future to today, representing that scenario planning entails first asserting future condition rather than using existing trends to predict the future conditions. Once the future has been asserted, the planner works back to the present, trying to understand impacts to our society today if that future scenario were to unfold.

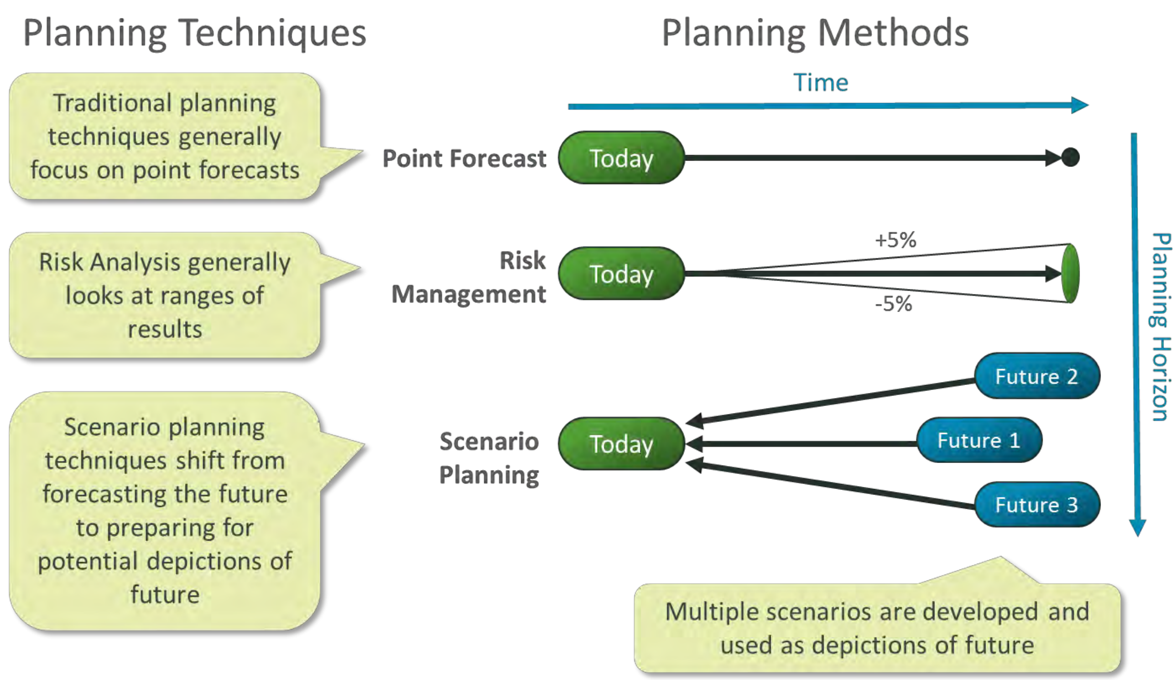


Figure E-1 Scenario Planning Versus Traditional Planning

1.4 DESCRIPTION OF THE FOUR STUDY SCENARIOS

The four scenarios used for this study are based on situations identified in the *NCHRP Report 750 Volume 1*.

The Future Freight Flows team at MIT's Center for Transportation and Logistics (CTL) developed the following future scenarios:

MILLIONS OF MARKETS

"**Millions of Markets**" – Through advanced technological breakthroughs, the United States becomes highly self-reliant in terms of energy, agriculture, manufacturing, and other needs. Local trade soars and consumer affluence rises as technology allows people to decentralize, moving away from highly concentrated population centers.

"**Global Marketplace**" – This is a highly competitive and volatile world. Open, vigorous trade between virtually all nations has led to market-based approaches to most contemporary challenges.

"**Naftástique"** – As world trade moves away from a global market, a number of regional trading blocs emerge. China, Europe, and South America form their own clusters. The United States leads an effort to make North America a self-sufficient economic community.

"**One World Order**" – Facing global scarcity of key resources, nations establish international rules to ensure their fair and sustainable use. Global trade thrives, but its course is shaped by the very visible hand of regulation, at times an iron fist in a velvet glove.

Ober the course of a year, MIT's CTL developed the four scenarios through a series of focused expert panel sessions, practitioner acid testing[1], and industry-wide surveys. The scenarios serve to illustrate and describe the benefits of scenario planning as a tool used in conjunction with other planning methods in order to improve the quality of long-range transportation infrastructure planning. Key driving forces and critical uncertainties were identified to form the basis of the underlying scenarios. While originally designed for freight transportation planning, they can be employed for a wide variety of different planning purposes.

In the context of this study, the four scenarios were presented to stakeholders at three outreach and public involvement workshops in Washington D.C., Ottawa, and Mexico City in February and March 2015. During these outreach activities, participants representing public and private interests in the United States, Canada, and Mexico were introduced to the concepts of scenario planning, and the stakeholders validated the use of the four scenarios. They also offered insights into the underlying drivers, as well as the direction and magnitude, of passenger and freight cross-border flows in North America under each of the proposed scenarios.

The study also included the following extensive outreach efforts to involve stakeholders from all three countries:

- A series of webinars for a broad set of stakeholders – including national policy experts, private sector representatives, transportation and traffic modelers, and experts in cross-border freight and passenger flows – was conducted in the fall of 2015. The webinars led to the review and approval of a passenger and freight flow framework for North America and the cross-border regions.

[1] A rigorous and conclusive test to establish worth or value of each of the four scenarios: Millions of Markets, Global Marketplace, Naftastique, and One World Order.

- A second round of in-person workshops were held in Washington DC, Ottawa, and Mexico City in June 2016 to discuss and solicit stakeholder feedback for the final project approach, assumptions, data sources, resulting scenario-specific crossing estimates, and findings.

1.5 OVERALL STUDY APPROACH

The US-Mexico border and the US-Canada border were divided into distinct regions: six regions identified for the US-Mexico border and seven regions for the US-Canada border, for a total of thirteen regions in the study. These regions divide the border areas into smaller units of analysis, allowing the information generated by the study to more closely respond to the needs of the state, regional, and local agency planning partners. The definition of these regions was kept consistent with other border master planning efforts as much as possible. **Figure E-2** shows a map of the locations of each of the thirteen border regions used for this study.

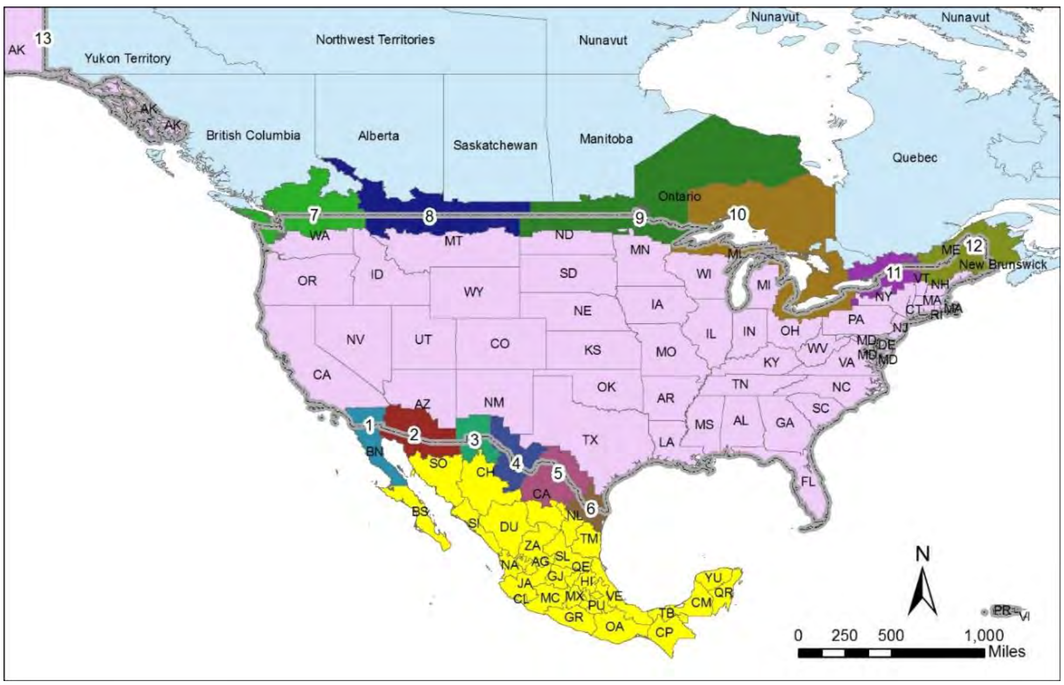


Figure E-2 Border Region Map

Source: Mapping for Scenario Planning of Future Freight and Passenger Traffic Flows across the US/Mexico and US/Canada Borders

There are six regions along the US-Mexico Border. These are:

- Region 1: California – Baja California
- Region 2: Arizona – Sonora
- Region 3: New Mexico – Chihuahua
- Region 4: El Paso – Santa Teresa

- Region 5: Laredo – Nuevo Leon
- Region 6: Lower Rio Grande Valley

There are seven regions along the US-Canada Border. These are:

- Region 7: Washington – Idaho – British Columbia
- Region 8: Montana – Alberta – Saskatchewan
- Region 9: North Dakota – Minnesota – Manitoba – Western Ontario
- Region 10: Michigan Area
- Region 11: New York Area
- Region 12: New England Area
- Region 13: Alaska – British Columbia – Yukon Territory

Data collected for the study were scaled to the regional level whenever possible. Population and employment data were available at the sub-state or sub-province level for each of the three countries involved in the study; border crossing/entry data from the USDOT's Bureau of Transportation Statistics were available at the land port level along both borders. Some data, such as fuel prices, were only readily available at the state or province level. Finally, some statistics were available at the national level, such as national unemployment rates.

Undertaking the first known border crossing study of this magnitude, the project team collected no primary data, such as traffic counts or travel surveys. The project team instead relied on readily available public data when possible and the *Complete Economic and Demographic Data Source 2015 Edition* from Woods and Poole Economics for mid-Census estimates and default long-term projections of socioeconomic data for US counties within the border regions. This emphasis on secondary data was intended to leverage existing data sources to the highest degree and reveal data gaps so that future similar studies might best to target their resources.

These data were analyzed to determine what, if any, relationships between the socioeconomic data and border crossings existed; this analysis would assist in developing a quantitative method for analyzing the impacts of each scenario. Population growth increases the overall number of potential crossings in the long term. Dynamic fluctuations in economic indicators, such as fuel prices, employment, and currency exchange rates, have more of an impact on the annual variation of border crossings than population growth does. Although in the long-term population increases can lead to a higher number of border crossings, sustained adverse trends in the economic drivers of border crossings can be expected to suppress this number, whereas favorable economic environments can have a multiplicative effect on border crossings growth. In other words, as the population grows over time, border crossings will increase as well, although a weak economy or weak foreign currencies may result in fewer border crossings than would otherwise be expected.

The project team developed a version of FHWA's Freight Analysis Framework 4 (FAF4) to measure each scenario's impacts to freight movements across the border. For the Naftastique scenario, changes in trade over time were defined by the *NCHRP 750* scenario specifications. For the other three scenarios, the team used assumptions to changes in Gross Domestic Product (GDP), combined with current account balances, to forecast changes in trade.

For passenger crossings, the project team developed a series of regionally specific linear regression models to estimate the significance and severity of each factor's impact to border crossings. The data analyzed included population, employment, and other economic indicators, along with historical border crossing data at each of the ports along both borders.

Key factors driving border crossing movements include population, employment/unemployment, currency exchange rates, fuel prices, and Gross Domestic/Regional Product (GDP/GRP). Growth in border crossing movements is positively correlated with population and employment growth and negatively correlated with increases to fuel prices. The value of each factor was adjusted in annual increments from 2015 conditions to the year 2045 in a manner consistent with the narrative provided for each of the four scenarios. The resulting border crossings were reported for each region.

1.6 FINDINGS

The study found that US-Mexico border crossing behavior is highly dynamic and intimately tied to the vibrancy of economic life along the border. Greater economic health, as reflected by low Mexican unemployment and vigorous growth in GRP on the US side of the border regions, drives border crossings more than any other factor. This activity can be suppressed by particularly high fuel prices. Region 1 (San-Diego / Tijuana), Region 4 (El Paso / Ciudad Juarez), and Region 6 (Brownsville / Matamoros) represent highly populated border communities with a long-standing history of cross-border cultural and economic interaction. Region 5 (Laredo / Nuevo Laredo) serves as the principal gateway for land-based freight traveling between the two countries. These densely populated regions experience the most significant changes to border crossings for each of the scenarios, while the more rural and lesser populated border regions tend to be less responsive to changes in socioeconomic conditions.

Approximately 25% of crossings between the US and Mexico are made by pedestrians. This number is expected to hold steady over the long-term unless there is a decrease in the efficiency of processing automobile crossings. In this case, the portion of bicycle and pedestrian crossings would be expected to increase.

Most passenger border crossings, whether on the US-Canada border or the US-Mexico border, are trips relatively short in length and typically confined to the neighboring border towns. Scenarios that improve economic activity and/or facilitate the integration of cross-border communities have the greatest potential to increase border crossing demand; only Region 3 appears to be relatively insensitive to these changes. This is likely due to the sparsely populated nature of the region.

Freight trips occur primarily by truck, although freight rail is well represented as well. **Table E-1** shows the US-Mexico border freight movements by scenario. Cross-border drayage makes up a significant portion of freight traffic. This drayage can be expected decline under a Naftastique scenario, as the open border policies envisioned in that scenario would eliminate the need for border dependent short hauls. With looser border controls, less cross-border freight would originate near the border region.

Table E-1 Freight Movements by Mode and by Scenario for US-Mexico Border

Scenario	Mode	Thousands of Tons						
		2015	2020	2025	2030	2035	2040	2045
Naftastique	Air	129	228	368	442	486	581	650
	Multiple	749	1,326	1,986	2,288	2,419	2,650	2,924
	Unknown	859	1,527	2,391	2,826	3,058	3,469	3,983
	Pipeline	16,971	24,957	37,023	38,537	36,315	37,428	39,956
	Rail	37,563	58,417	89,593	99,921	100,344	108,446	118,657
	Truck	81,287	137,766	213,304	245,172	257,561	286,840	322,622
	Water	109,052	157,634	219,138	228,578	217,758	223,018	234,238
Global Marketplace	Air	129	168	220	279	359	486	597
	Multiple	751	932	1,145	1,399	1,735	2,217	2,714
	Unknown	859	1,093	1,390	1,734	2,191	2,857	3,610
	Pipeline	16,915	19,510	23,048	25,323	27,950	31,959	37,066
	Rail	37,515	43,754	54,176	63,953	75,343	92,548	111,226
	Truck	81,272	100,939	126,438	153,411	188,391	239,461	295,827
	Water	109,093	115,494	131,469	146,037	163,975	192,076	221,886
One World Order	Air	129	160	198	240	296	388	460
	Multiple	748	883	1,023	1,186	1,405	1,728	2,041
	Unknown	858	1,041	1,248	1,479	1,790	2,250	2,741
	Pipeline	17,028	18,850	20,966	21,976	23,349	25,845	28,925
	Rail	37,611	41,950	48,955	55,007	62,169	73,722	85,480
	Truck	81,303	96,478	113,936	131,445	154,704	189,701	226,127
	Water	109,010	110,070	118,103	124,768	134,413	152,207	169,817
Millions of Markets	Air	129	166	210	262	326	428	509
	Multiple	749	930	1,112	1,326	1,569	1,927	2,275
	Unknown	859	1,087	1,342	1,639	1,986	2,497	3,045
	Pipeline	16,971	19,186	21,715	23,640	25,470	28,345	31,826
	Rail	37,563	43,277	51,661	60,081	68,455	81,395	94,563
	Truck	81,287	100,112	121,284	144,556	170,986	209,959	250,634
	Water	109,052	114,641	126,096	137,405	148,628	168,430	188,152

US-Canada border crossing behaviors are less volatile than those along the US-Mexico border. Region 10 (Detroit / Toronto / Niagara) shows characteristics similar to the more dynamic US-Mexico border crossings regions, but recent history has shown that border crossings in this region are declining. The decrease in regional manufacturing employment on the US side explains the reduction in border crossings from 1995 to 2014 better than any other factor. Though the crossings may not be tied directly to manufacturing employment, the loss of such employment over the past two decades has had other incidental impacts to the character of the region, making predominantly short-distance discretionary trips into the US from Canada less desirable. However, border crossings are positively correlated with a higher Canadian Dollar to US Dollar exchange rate. A strong Canadian dollar can stimulate growth in border crossings to some degree as Canadian residents seek to leverage greater purchasing power in the US. Region 10 also serves as the largest gateway for freight of either border of the US.

Along the US-Canada border, only Region 7 (Washington / British Columbia) has seen increases in border crossings since 2008. The other regions along the US-Canada border, including Region 10, have experienced a sustained period of decline in border crossings. These regions are responsive to growth in population and employment and as these increase, the number of border crossings can be expected to increase.

Passenger crossings along the US-Canada border are typically less affected than they are along the US-Mexico border. Only Regions 11 and 13 show consistent growth across all scenarios. When growth does occur for the other regions, the numbers of crossings achieved by 2045 are frequently less than the highest levels of cross-border traffic observed for those regions within the past 20 years. US-Canada crossings are overwhelmingly automobile-oriented, with a smaller portion occurring by bus. Pedestrian crossings are virtually non-existent as a share of all crossings except in Region 10, where tourists traversing the border at Niagara, hoping to take in a view of the waterfalls, comprise most of the crossings.

Freight modes are highly diversified, with truck freight being a majority share only in Regions 11 (New York / Montreal) and Region 12 (New England / Quebec / New Brunswick). **Table E-2** lists scenario specific freight tonnages by mode for the US-Canada border.

Table E-2 Freight Movements by Mode and by Scenario for US-Canada Border

Scenario	Mode	Thousands of Tons						
		2015	2020	2025	2030	2035	2040	2045
Naftastique	Air	230	389	654	751	871	1,058	1,196
	Multiple	9,692	14,880	22,736	24,434	26,605	29,376	32,744
	Unknown	438	696	1,089	1,245	1,456	1,699	1,945
	Pipeline	224,520	309,850	385,707	389,572	396,844	383,094	386,039
	Rail	104,191	146,504	201,822	213,225	232,246	245,255	266,497
	Truck	128,718	193,904	290,346	312,894	342,759	376,246	419,011
	Water	110,432	146,850	188,704	181,340	176,929	172,341	173,196
Global Marketplace	Air	230	297	394	495	631	851	1,052
	Multiple	9,679	11,652	14,371	16,997	20,330	25,213	30,772
	Unknown	438	559	721	900	1,136	1,486	1,863
	Pipeline	225,021	262,571	284,067	312,039	335,299	366,290	402,735
	Rail	104,299	120,972	141,077	162,936	189,910	226,561	269,210
	Truck	128,644	154,309	188,632	222,832	266,066	327,928	399,625
	Water	110,405	118,232	125,807	132,761	141,098	155,219	171,391
One World Order	Air	231	286	358	429	527	689	821
	Multiple	9,706	11,183	12,998	14,636	16,806	20,131	23,712
	Unknown	438	535	650	771	934	1,179	1,426
	Pipeline	224,017	248,634	253,304	263,581	270,368	284,087	301,128
	Rail	104,083	115,048	126,412	138,557	154,475	177,511	203,422
	Truck	128,793	147,692	170,196	191,317	219,189	260,907	306,893
	Water	110,458	112,864	113,040	113,340	115,413	122,448	130,378
Millions of Markets	Air	230	293	373	464	576	755	903
	Multiple	9,692	11,520	13,694	15,963	18,483	22,203	26,206
	Unknown	438	555	692	848	1,032	1,304	1,580
	Pipeline	224,520	262,027	275,731	295,349	302,492	317,394	336,497
	Rail	104,191	120,347	136,134	153,877	171,824	197,430	226,428
	Truck	128,718	152,851	180,370	209,576	241,643	288,212	339,589
	Water	110,432	117,228	120,463	124,822	127,770	135,770	144,782

1.7 CONCLUSIONS AND RECOMMENDATIONS

Freight crossings for all scenarios and all regions are expected to increase over time – what differs is the rate at which they increase. Scenarios such as Naftastique show rapid front loaded growth; the Global Marketplace scenario results in nearly the same amount of increase in freight crossings by 2045, but takes much more time to reach those numbers. In a Naftastique future, there is a greater sense of urgency in addressing the needs of increased demand, whereas there is more time available to respond to the trends in Global Marketplace. The One World order scenario shows the least amount of growth while the Millions of Markets scenario is very similar to FHWA's FAF4 baseline forecast.

Figure E-3 shows total freight crossings per scenario for both borders combined. Included are results for each of the four scenarios: Naftastique (NFTQ), Global Marketplace (GMKT), One World Order (OWO), and Millions of Markets (MOM). The baseline FAF4 forecasts are included for reference.

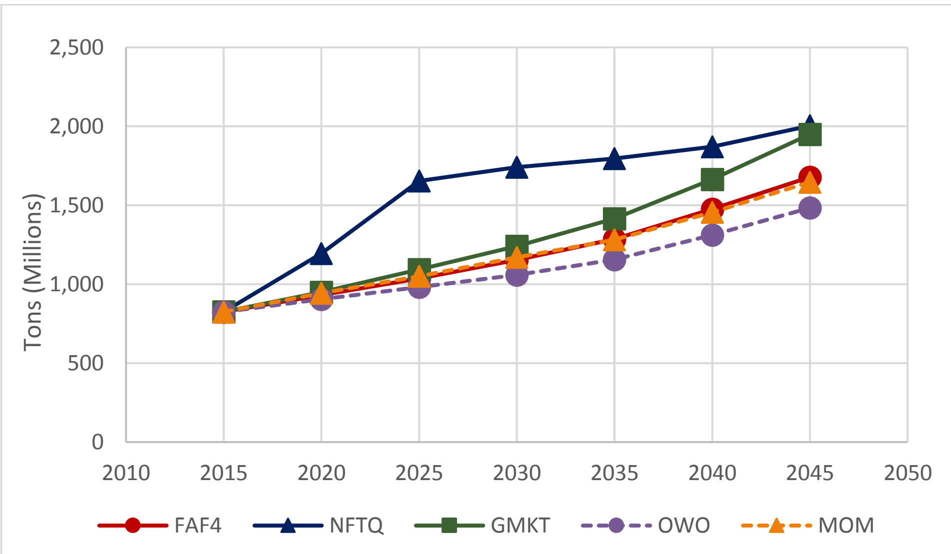


Figure E-3 Annual Freight Crossings US-Mexico and US-Canada Borders Combined

Source: Results from Scenario Planning of Future Freight and Passenger Traffic Flows across the US/Mexico and US/Canada Borders

The US-Mexico border is highly responsive to the economic factors that drive crossings. Expected crossings range from unprecedented highs that could strain existing infrastructure and manpower, to historic lows that are well within existing capabilities to manage. In particular, the strength of long-term economic growth in Regions 1, 4, and 6 should be monitored closely – the stronger the growth of the economy in these regions, the more likely it is that border crossing demand will exceed capacity. As crossings increase, the number of bicyclists and pedestrians crossing the border will also increase, creating new concerns with respect to bicycle amenities, pedestrian safety, and access to public transport.

The US-Canada border is less susceptible to passenger crossing issues, as it remains affected by long-standing socioeconomic pressures that have reduced the number of border crossings. Region 10 is unlikely to regain the high levels of border crossings it achieved in 1996 by this study's 2045 horizon. To the extent that it comes close, it would depend upon a resurgence of the region's economy through either a renaissance in manufacturing or a complete revolution in region's economy, such that some other sector replaces and surpasses the area's long-standing reliance on manufacturing. Region 11 is poised to see consistent long-term growth in border crossings, assuming that Canada's pattern of population migration to communities along the US border continues. Region 13, though holding a much smaller share of all border crossings, is likewise set to experience significant growth relative to its current levels of border crossings, nearly doubling in each scenario. Region 7 may rise or fall, depending primarily on Canadian employment growth. An interesting feature of the Canadian border is that for Regions 7, 11, and 12, border crossings are negatively correlated to Canadian employment. Presumably, employment rate increases on the Canadian side of the border better satisfy the economic needs of Canadian residents, making them less likely to seek goods and services in the US. A weaker Canadian Dollar could also suppress border crossings as Canadian residents find their purchasing power reduced in the US.

Figure E-4 shows the results of the passenger border crossings for each scenario for the US-Mexico and US-Canada borders combined. A prevailing trend (PT) estimate representing an extension of present-day assumptions about the future is provided for reference.[2]

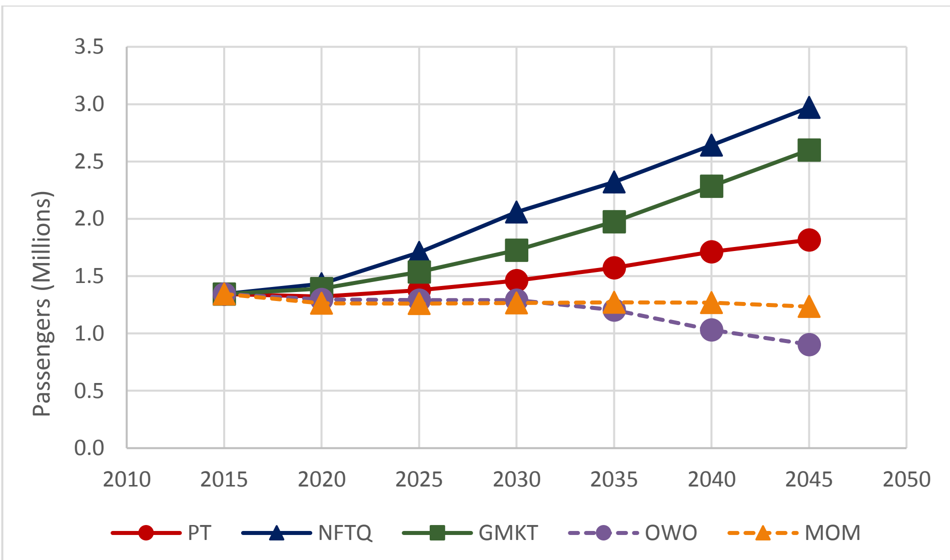


Figure E-4 Daily Passenger Crossings US-Mexico and US-Canada Borders Combined

Source: Results from Scenario Planning of Future Freight and Passenger Traffic Flows across the US/Mexico and US/Canada Borders

Each region proved to be a unique area with respect to border crossing behavior, and more research at the regional level is necessary to better understand these dynamics. Many of the regions are well populated and contain Metropolitan Planning Organizations (MPOs) on the US side that are tasked with planning for long-term transportation needs. These MPOs use transportation models to forecast travel demand, which often treat the border ports as external stations with cross-border trips determined by a simple process of linear extrapolation, or a traffic growth rate based directly on population growth. Some areas, such as Southern California, have been investing in better ways of modeling their cross-border demand. Others, such as the City of El Paso, are trying to improve their data environment through a multi-agency partnership with a mobile app vendor. A better

[2] Prevailing Trend represents a baseline forecasting assumption without respect to scenario specific changes.

understanding of origins and destinations acquired by leveraging emerging data technologies will help to illuminate many of the border crossing behavior knowledge gaps.

2. INTRODUCTION & OBJECTIVES

2.1 BACKGROUND

This document is part of the study titled "Scenario Planning of Future Freight and Passenger Traffic Flows across the US/Mexico and US/Canada Borders." This study is aimed at applying the principles of scenario planning to estimate the impacts of hypothetical combinations of global socioeconomic situations on passenger and freight border crossings at the US-Canada and US-Mexico borders. In this document, these hypothetical situations are referred to as scenarios. By using a scenario-based approach, it is possible to gain a broader understanding of the underlying factors that might influence border crossing behavior, as well as the range of uncertainty regarding these future border crossing estimates.

2.2 STUDY OBJECTIVES

This study addresses freight and passenger border crossings at the US-Canada and US-Mexico borders and has the following primary objectives:

- Develop an analytical framework to represent freight and passenger border crossings.
- Use the analytical framework to forecast passenger and freight demand.
- Apply scenario planning as a tool to identify hypothetical scenarios that may affecting border crossings.
- Quantify the impact of the scenarios on passenger and freight border crossings through 2045.

2.3 INTRODUCTION TO SCENARIO PLANNING

Scenario planning is a technique used to better prepare for the future by developing multiple plausible situations, or scenarios, representing alternative futures rather than committing to prepare for a single expected future. Recent history has suggested that the traditional approach of attempting to predict the future as a continuation of current or historical trends and then planning accordingly does not accommodate the inevitable uncertainty of events, or "shocks." Organizations that have realized this flaw in the traditional planning approach have begun to adopt the scenario planning approach.

Figure 2-1 provides a summary of the differences between traditional planning and scenario planning approaches.

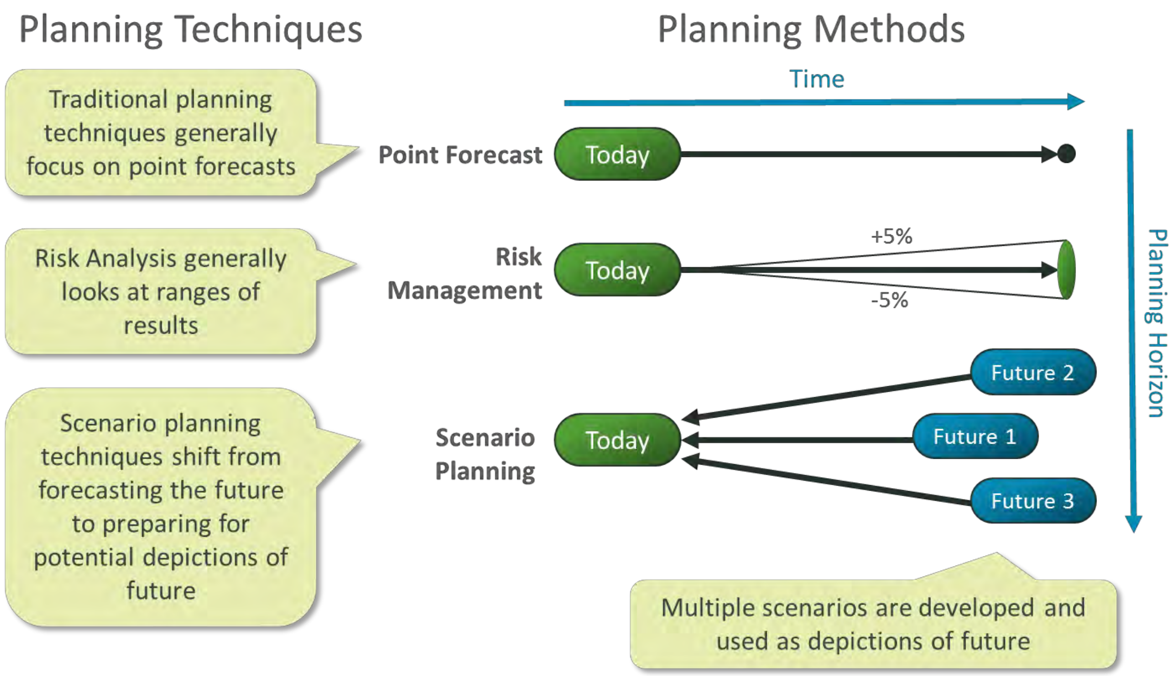


Figure 2-1 Scenario Planning Versus Traditional Planning

As shown in **Figure 2-1**, the traditional planning approach looks at a point forecast, or a model that spans from the present day to a certain point in future. This approach is generally based on assumed future values of present trends and neglects to examine any additional combinations of factors.

A second level of planning, which is somewhat more comprehensive than the point forecast, is risk analysis, which involves analyzing a large number of factor combinations with varying percent changes. Like the traditional point forecast approach, the starting point of the risk analysis is the present day rather than the future years, or a "planning horizon," for which the plans are prepared.

The scenario planning approach, however, starts with several plausible future conditions called scenarios (shown as Future 1, Future 2 and Future 3 in **Figure 2-1**), and then uses present-day data to analyze these scenarios. In this way, the planner is able to envision a number of likely outcomes and determine necessary remedial or preparatory actions. Scenario planning allows the planner to consider possibilities that are often disregarded in the trend-based perspective that marks traditional forecasting; this approach provides organizations with an awareness of potential disruptions and encourages them to consider appropriate contingencies. For example, a traditional trend-based forecast was unlikely to have predicted Britain's decision to exit the European Union. As such, many organizations today are struggling assess the implications and adjust their plans accordingly. A scenario-based approach might have envisioned such an event, or one similar with implications that could be easily translated.

The four scenarios used for this study were based upon MIT's findings in "Scenario Planning for Freight Transportation Infrastructure Investments," published in the *NCHRP 750*. These scenarios are represented by the images shown in **Figure 2-2**.

Figure 2-2 Scenarios Identified in Current Study

3. LITERATURE REVIEW

Early in the scenario planning process, the project team conducted a literature review. The literature review primarily focused on the work and lessons learned in the *National Cooperative Highway Research Program Report 750 Series: Strategic Issues Facing Transportation (NCHRP 750)* and the FHWA National Corridor & Gateway Concepts projects. This review helped to identify any significant advances in data availability or changes in policy or global economic trends that might require a reassessment of the scenarios developed for NCHRP 750. The review was also instrumental in determining the extent to which scenario planning exercises have been conducted in the past with respect to border crossing behavior.

Given the inconsistencies in data coverage and reporting history for cross-border datasets and international merchandise trade statistics, the literature review also attempted to describe data and modeling gaps that would need to be addressed for this study. The project team's knowledge of these gaps and existing data informed the analytical methodology, and may also serve to guide future data collection efforts conducted to support future iterations of this study. A review of *NCHRP 750* can be found in **Appendix-A**.

The project team established the following four objectives for the literature review:

- To build an understanding of prior work from *NCHRP Web-Only Document 195: Driving Forces Influencing Future Freight Flows*, *NCHRP 750* and FHWA National Corridor & Gateway Concepts projects.
- To support validation of the assumptions that formed the framework for the *NCFRP 750* scenarios.
- To review and evaluate existing economic and travel modeling tools for the development of macro-level cross-border scenario plans.
- To review data sources, coverage, and historical reporting for cross-border datasets and international merchandise trade statistics.

3.1 SCENARIO PLANNING IN CANADA AND MEXICO

The project team did not uncover any examples of a scenario-based analysis of border crossing traffic conducted for the US-Canada border. At most, existing cross-border forecasting employed point forecasting with a bounded error range. For example, typical freight flow projections used in the analyses of Canadian transportation systems tend to rely on this point forecasting approach to establish a baseline case, along with optimistic and pessimistic-type cases. No information identifying scenario planning activities in Mexico was found during the literature review. As such, it was imperative to educate participants on the scenario planning concept during outreach events in Canada and Mexico.

3.2 PUBLIC AND PRIVATE SECTOR INVOLVEMENT

NCHRP 750 and the FHWA National Corridor & Gateways projects differed in their management of public and private sector participants. During the *NCHRP 750* workshops, public and private sector participants interacted with each other; for the FHWA National Corridor & Gateway project, however, separate events were held for the private and public sectors. While both are acceptable approaches, the *NCHRP 750* approach was better suited for the established freight partnerships, which have a long history of public and private sector interaction. The Gateways project was more focused on bringing together a diverse group of private stakeholders that had not worked together in the past. This comparison of approaches led the project team to consider the cultural context of each national and international partner prior to organizing outreach events.

3.3 CURRENT RELEVANCY OF SCENARIO DRIVING FORCES

The US-Mexico Border Master Plans (BMP), which analyzed the impacts of the global trade in the border region, were largely congruous with the driving forces used to develop the *NCHRP 750* scenarios. Specifically, the BMPs anticipate increased global trade with the Pacific Rim in the future and, as a result, additional cargo arriving from the proposed Mexican Ports in Punta Colonet and Guaymas. Furthermore, the US-Mexico BMPs identify two additional driving forces not identified in *NCHRP 750*: the rise of mega-distribution centers along the border and significant population increases on the Mexican side of the border. An inventory of the BMPs is found in **Appendix-B**.

StatsCanada also noted increased growth on the Canadian side of the border as distinct from the *NCHRP 750* driving factors. These additional driving factors were taken into consideration when crafting the scenario analyses for this study.

3.4 APPLICABILITY OF THE *NCHRP 750* SCENARIOS

While the driving forces used to develop the four scenarios in *NCHRP 750* were still relevant despite being five years old, the *NCHRP 750* project only dealt with freight transportation – passenger transportation was not considered at all. Therefore, forces driving passenger movements were not included in those scenarios. For passenger travel, it was necessary to conduct an additional exploration of data variables that could contribute to crossing behavior. This process is discussed in greater detail in **Section 6.5** of this report.

The scenarios presented in *NCHRP 750* were represented in the published materials in terms of broad macroeconomic impacts. The scenarios in NCHRP 750 did not go into the details of the modal distribution of cargo, however. This study had to address the issue of freight modes when determining scenario specific impacts, which is discussed more in **Section 6.7** of this report.

3.5 MEXICAN-BASED DATA SOURCES

While data available from the Mexican Census offered information on Mexican population and employment along the border, the project team did not discover a survey similar to the United States' Commodity Flow Survey or the associated Freight Analysis Framework. Passenger travel information was gleaned from border crossing surveys conducted by communities on the US side of the border.

3.6 CANADIAN DATA GAPS

The most prominent gap in Canada-US border data is truck data and information about the movement of commodities. Many of those experts consulted noted that Canada does not have a Commodity Flow Survey or an associated Freight Analysis Framework. A number of the reviewed models highlighted a gap at border crossings and attributed this gap to the lack of data surrounding the origins and destinations of commercial vehicles entering or leaving Canada. Without commodity and origin/destination data, planning organizations are limited in their ability to plan for scenarios that are influenced by sector-specific economic growth. The models are limited to projections based on historical border counts or forecasts from previous studies such as the National Commodity, Trade, and Traffic Forecasts Study.

3.7 EXPERIENCE IN TRANSLATING SCENARIO RESULTS INTO FLOWS

The literature review revealed that few studies translate scenario planning results into freight and passenger flows at this level of detail. The *NCHRP 750* project purposely did not produce any quantitative scenario forecasts. Initially, *NCHRP 750* included the firm IHS in discussions concerning the project and long-term goals of using models to quantify the scenarios; however, it was ultimately decided that developing detailed quantitative results for each scenario would be counter-productive to the project objectives.

Scenario planning is intended to be a qualitative exercise in conceptual planning. As a technique, scenario planning has more similarities to thought experiments that inform the highest levels of strategic planning than it does to the more quantitative techniques usually reserved for transportation studies. This current study is relatively unique, as it represents a convergence of these two approaches, grounding the high-level conceptual aspects of scenario planning to the concrete methods of quantitative analysis typically employed in transportation planning.

3.8 APPLICABILITY OF CURRENT MODELS

The project team reviewed a number of models along the US-Mexico and the US-Canada borders, analyzing their basic characteristics, such as data structures and trip behavior methods. An inventory of these models is documented in **Appendix-C**. The applicability of the models to this scenario planning study was subject to many considerations, including:

- The variety of approaches within each model in terms of basic approach, level of detail, and forecasting methodology.
- The different approaches to cross-border traffic for both passenger and freight.
- The age of the data collected for the development of each of the models.

Based on these and other considerations, it was not desirable to directly use the models for this study. The differences in the structures of these models make it nearly impossible to merge them into a single cohesive framework, and the lack of consistency between models would mean that an analysis for a given locale might be based on inappropriate data and techniques. Furthermore, these models were designed to provide "point forecasts," not the broad-based scenario forecasts needed for the study. The lack of sensitivity to a variety of planning scenarios would limit the models' abilities to provide the level of analysis required by this study.

Finally, the primary requirement for Scenario Planning is to have a similar framework for regions along both borders in order to allow valid comparisons between communities. The diversity of data and techniques used for the border community models was unsuited to the task of a border crossing study of this magnitude. This study required a unified framework of data and models to meet the objectives. The remaining sections in this document describe how this framework was developed and applied.

3.9 DATA SOURCES

Another objective of the literature review was to identify secondary data sources that might provide information necessary for the development stage of the framework. For this purpose, an extensive review of such resources was conducted, resulting in the identification of various datasets, as well as details of their data structure, frequency of updates, etc. A list of data sources is shown in **Appendix-D**. Data relevant to this study are discussed in **Section 4** of this document.

4. DATA COLLECTION

4.1 SCOPE OF DATA COLLECTION

This section provides a summary of the data obtained for the Scenario Planning of Future Freight and Passenger Traffic Flows across the US/Mexico and US/Canada Borders study. Though the project team did not conduct primary data collection (i.e., traffic counts or travel surveys), they did identify and collect an extensive amount of secondary data from existing public resources. Specifically, data were obtained for the development of macro- and micro-frameworks for the analyses/forecasts of future border crossing demands under various possible and assumed scenarios. Data were acquired from public sources over the internet and through direct correspondence with pertinent agencies.

Border crossing demand (or any travel demand) is a function of demographic and socioeconomic conditions within the area of interest. The most common factors considered in smaller area travel analyses include population density and employment, which are functions of future land-use and socio-economic conditions. Due to the international nature of the study, the project team also investigated other factors that might provide insights into variations of border crossing demands over time. The data collection effort focused on gathering the following historical data:

- Border crossing history.
- Population.
- Employment and unemployment rates.
- GDP.
- Gasoline prices.
- Currency rate fluctuations.

Data were collected in such a way so as to obtain internally consistent and equally detailed data at a comparable geopolitical level. For example, in the US, most data were collected at the County level; for Mexico, it was the Municipality level; and for Canada, it was at the Census Division level.

4.2 BORDER REGIONS

The US-Mexico border and the US-Canada border were divided into regions for the study for smaller units of analysis that capture the unique characteristics of each region; allowing the information generated by the study to better meet to the needs of state, regional, and local agency planning partners. The definition of these regions was kept consistent with other border master planning efforts to the extent possible. These regions provided a basic guideline for scaling the data to a geographic level that facilitated analysis and the development of region-specific macroeconomic models.

Figure 4-1 illustrates the definition of the border regions.

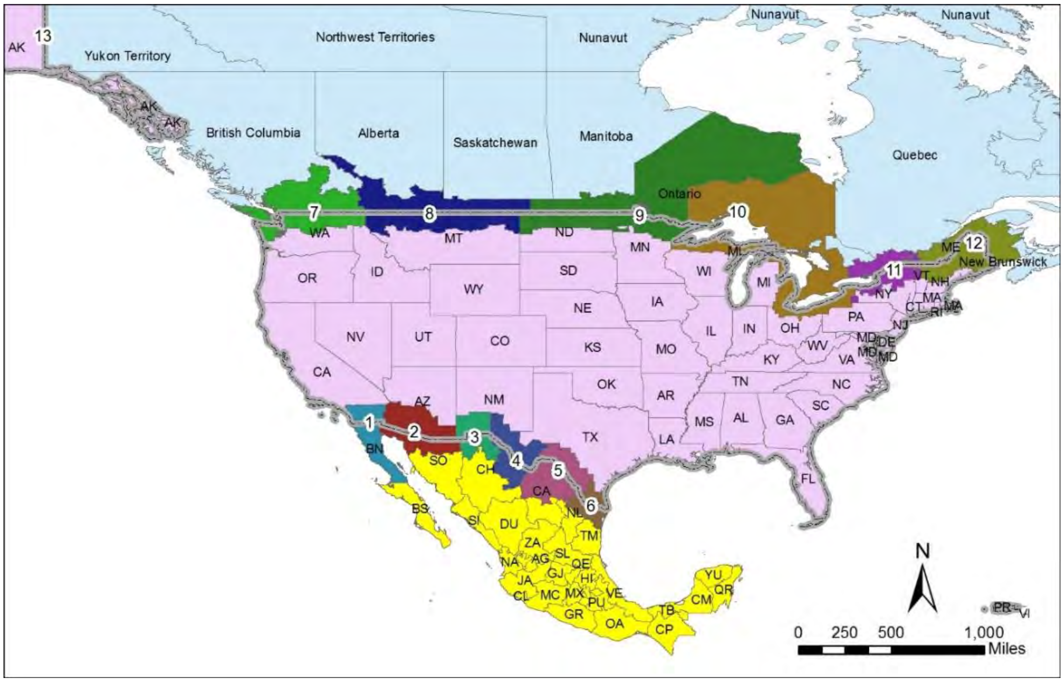


Figure 4-1 Border Regions

Source: Mapping for Scenario Planning of Future Freight and Passenger Traffic Flows across the US/Mexico and US/Canada Borders

There are six regions along the US-Mexico Border. These are:

- Region 1: California – Baja California
- Region 2: Arizona – Sonora
- Region 3: New Mexico – Chihuahua
- Region 4: El Paso – Santa Teresa
- Region 5: Laredo – Nuevo Leon
- Region 6: Lower Rio Grande Valley

There are seven regions along the US-Canada Border. These are:

- Region 7: Washington – Idaho – British Columbia
- Region 8: Montana – Alberta – Saskatchewan
- Region 9: North Dakota – Minnesota – Manitoba – Western Ontario

- Region 10: Michigan Area
- Region 11: New York Area
- Region 12: New England Area
- Region 13: Alaska – British Columbia – Yukon Territory

4.3 BORDER CROSSING DATA

The border crossing data were obtained from the USDOT Bureau of Transportation Statistics (BTS) via the Border Crossings/Entry Data searchable database. This database provides a comprehensive account of surface crossings at each US border port. The BTS database was queried for all data at all locations for years from 1995 through 2014. A spatial analysis was conducted to link the border crossings with the border regions, and the data was then tabulated by border regions.

Figure 4-2 shows passenger crossings along each of the borders for the period from 1995 to 2014. The teal line represents crossings into the US from Mexico; the blue line represents crossings into the US from Canada. Comparing the two borders, it is immediately apparent that border crossing activity is more intense along the US-Mexico border than it is along the US-Canada border. It is also apparent that border crossing activity is more volatile along the US-Mexico border than it is along the US-Canada border. Crossings from Mexico range from a high of 293 million passengers per year in 1999 to a low of 153 million passengers per year in 2011, whereas crossings from Canada peak at 105 million passengers per year in 1996 and reach a low of 56 million passengers in 2009. This represents a change of 140 million crossings along the US-Mexico border as opposed to a change of 49 million crossings along the US-Canada Border.

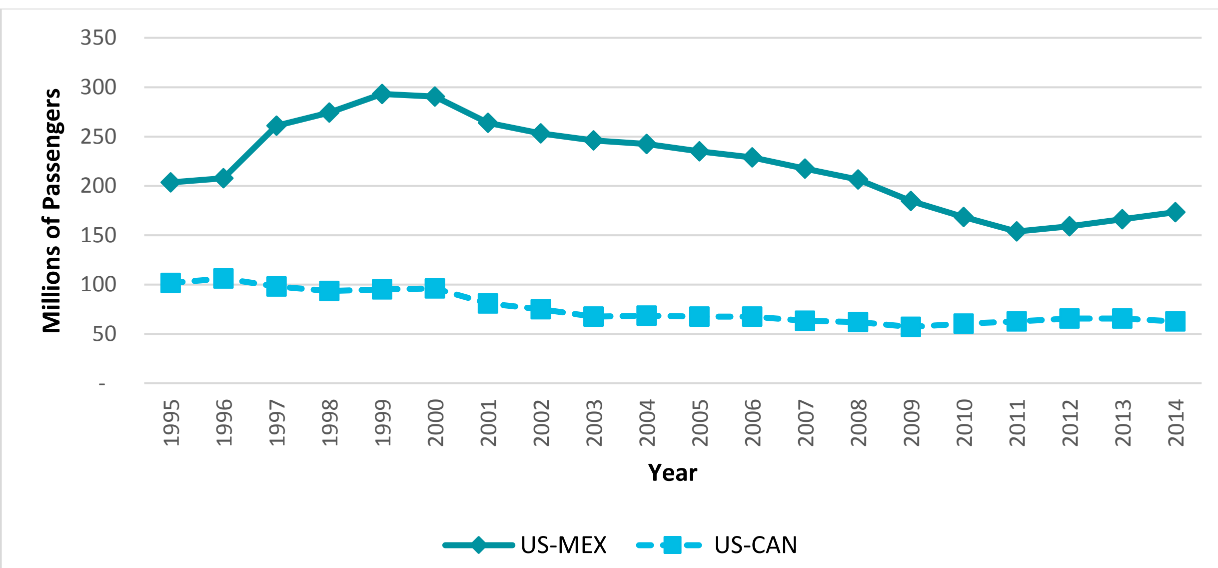


Figure 4-2 Annual Incoming Passenger Crossings by US-Canada and US-Mexico Borders (1995-2014)

Source: Bureau of Transportation Statistics Border Crossing/Entry Data

The other pattern of note in this graph is that passenger crossings trend toward fewer crossings over time; this is generally true for the US-Canada border throughout the entire period of analysis. Despite occasional fluctuations from year to year that show short-term growth in border crossings, the overall trend reveals fewer crossings over time.

The situation along the US-Mexico border is slightly different. Prior to 2000, the US-Mexico border was experiencing a surge in border crossings. This seems to have stopped abruptly in 2000, and after 2001 the number of crossings began to drop. This trend continued until reaching a low point in 2011 and then began recovering as crossings gradually increased in following years. While it is possible that the aftermath of the September 11th attacks in the US impacted border crossing procedures, which might partially explain this downward trend, it should be noted that US-Mexico border crossings had already fallen from 293 million passengers in 1999 to 290 million passengers in 2000.

Figure 4-3 shows passenger US-bound border crossings along the US-Mexico border on a monthly basis for the years 1999 through 2002. The blue line shows monthly crossings for 1999; the red line shows monthly crossings for 2000; the green line shows monthly crossings in 2001; and the purple line shows monthly crossings for 2002. As can be seen from the graph, monthly crossings for 1999 and 2000 were fairly consistent with one another, with the exception that there were noticeably less crossings in June 2000 than there were in June 1999. The 2001 monthly crossings appear to be fairly consistent with the data from January to April in 1999 and 2000. Starting in May 2001, crossings became significantly lower. This trend continued until September, when a sudden decrease in monthly crossings becomes apparent. The crossings remain suppressed until they began to recover in December of 2001.

The monthly crossing variation in 2002 paralleled the monthly variation of 1999 and 2000, but at a lower degree of intensity. Interestingly, the number of crossings in 2002 from May through August were very close to what they had been in 2001 for the same months. For the rest of 2002, the number of crossings is greater than what they were in 2001, though still less than what they were in 1999 and 2000. It is clear from the graphs that a negative trend in monthly border crossings began four months prior to the September 11th attacks. Though the attacks had a definite impact on border crossings in the immediate aftermath, it is likely that the sustained long-term decline in US-Mexico border crossings noted in **Figure 4-2** is due to other underlying factors.

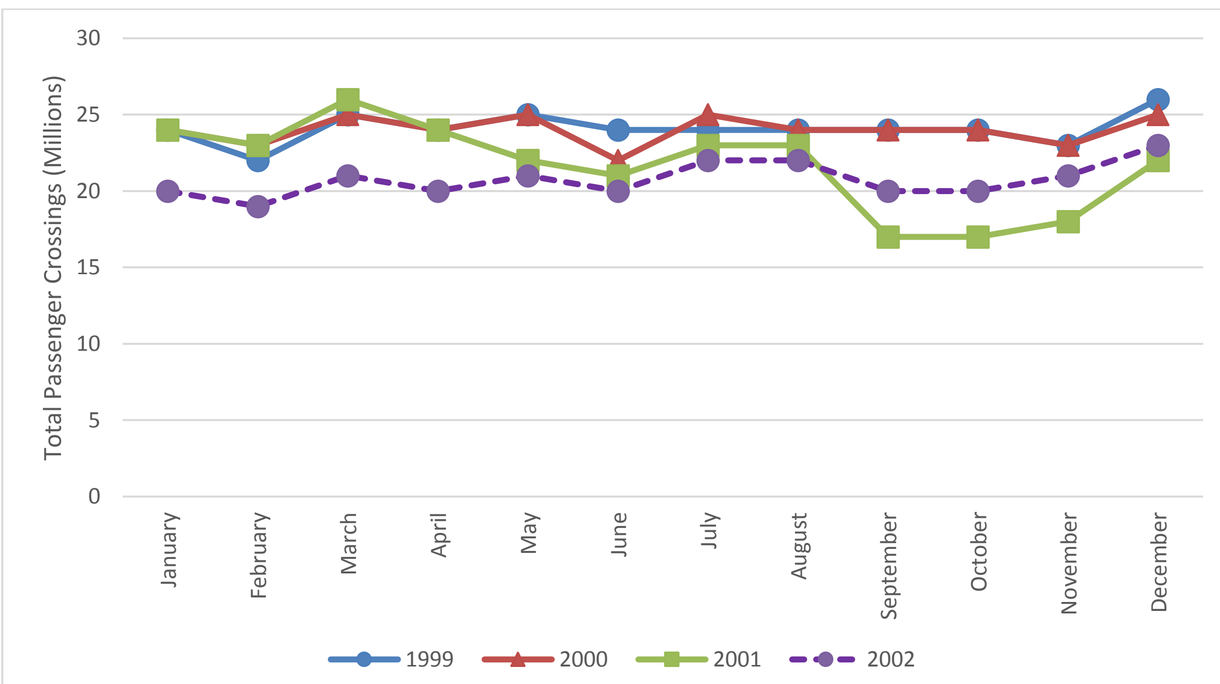


Figure 4-3 Monthly Variation in Passenger Crossings along US-Mexico Border (1999-2002)
Source: Bureau of Transportation Statistics Border Crossing/Entry Data

Figure 4-4 shows the total passenger border crossings by region for the US-Mexico border, while **Figure 4-5** shows the total passenger border crossings by region for the US-Canada border. Regions 1, 4, 6, 10, and to a lesser extent Region 7, all show the greatest variations; these regions are also among the most urbanized areas along the borders. The other regions tend to be more rural and also show less variation in border crossings. The more intense levels of socioeconomic activities in the highly urbanized border regions represent greater opportunities for interactions across the border. As such, these regions appear to be much more sensitive to factors driving passenger border crossings. The process of discovering and quantifying these factors is discussed in more detail in **Section 6** of this report. Based on the historical data, these are the regions that one should expect to be more responsive to scenario-dependent changes that influence passenger crossings.

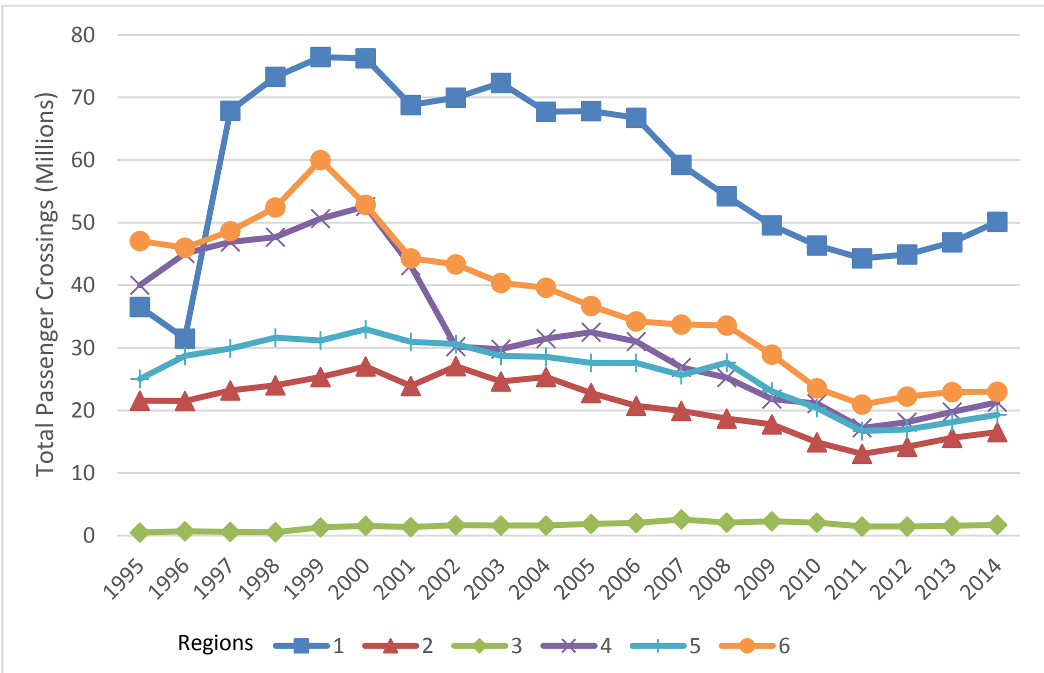


Figure 4-4 Annual Incoming Passenger Crossings by Region along the US-Mexico Border (1995-2014)

Source: Bureau of Transportation Statistics Border Crossing/Entry Data

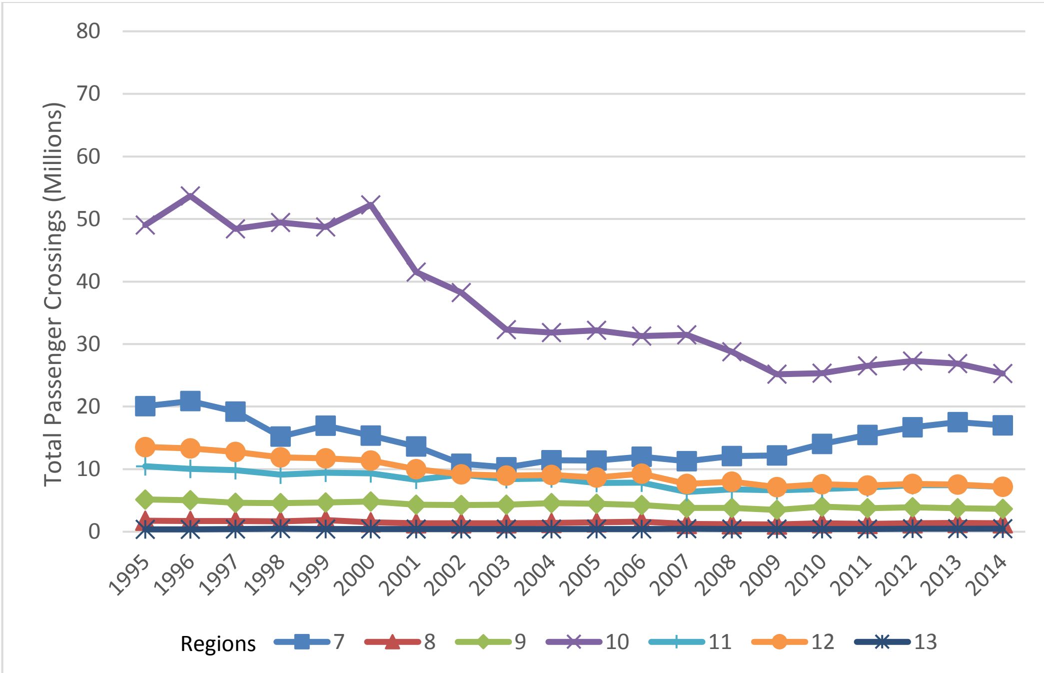


Figure 4-5 Annual Incoming Passenger Crossings by Region along the US-Canada Border (1995-2014)

Source: Bureau of Transportation Statistics Border Crossing/Entry Data

Figure 4-6 shows annual border crossings for truck traffic along the US-Mexico and the US-Canada border from 2000 to 2014. The blue line shows crossings from Mexico into the US and the red line shows crossings from Canada into the US. Unlike the passenger crossings, the truck crossings between the US and Canada are of greater intensity and volatility than the truck crossings along the US-Mexico border. The traffic from Mexico has been gradually increasing while truck traffic from Canada has been generally decreasing.

Freight movement from both countries observe a notable drop in 2009, consistent with the Great Recession, but recover somewhat by 2010. By 2014, truck crossings from Mexico have already reasserted their pre-recessionary trends and truck crossings from Canada appear to have reversed their previous downward trend. As expected, fluctuations in truck traffic appear to be heavily dependent on factors impacting transnational economic trade, and show little to no evidence of having been significantly influenced by the September 11th attacks.

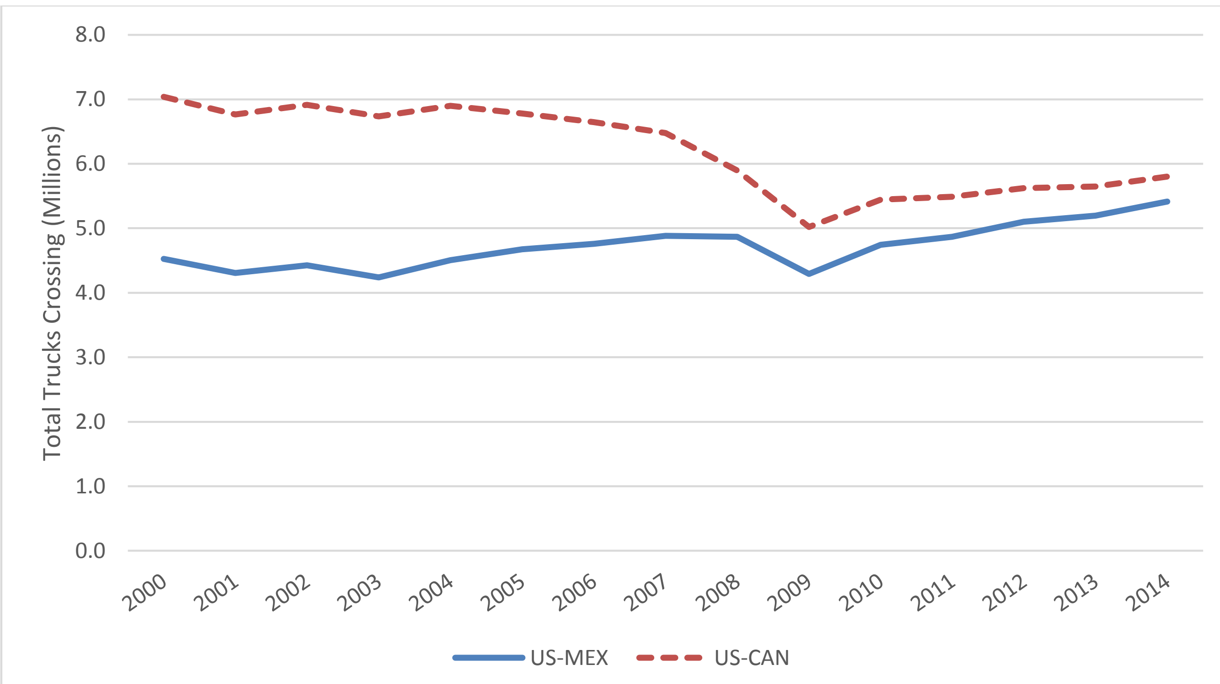


Figure 4-6 Annual Incoming Truck Crossings by US-Canada and US-Mexico Border (1995-2014)
Source: Bureau of Transportation Statistics Border Crossing/Entry Data

4.4 US POPULATION DATA

Data related to the US population was collected from the US Census Bureau at the county level and aggregated by border region. These data were collected for the period from 1980 through 2010. **Figure 4-7** shows a summary of state populations along the US-Mexico border, whereas **Figure 4-8** shows similar information for states along the US-Canada border. Population growth has continued to increase in all border states to a greater or lesser extent during this period, with the exception of Michigan. In 2010, Michigan had less population than it did in 2000.

Given that border crossings generally decreased during the period of 1995 through 2014 while population generally increased, it is difficult to establish a direct correlation between the two. In traditional travel demand forecasting practices, a correlation between the number of trips generated and the amount of population in a given region is positive and fairly direct: as population increases, so do the trips that are made. With respect to border crossings, though, this correlation does not appear to happen during the 25-year period. While this would seem to discourage the use of population as a vector for establishing future border crossings, it is important to bear in mind that border crossings represent a specific decision about *where* to travel rather than a decision of whether *to* travel. More people will still amount to more trips – it is a question of whether those trips would involve cross-border movements. The decision to cross the border depends on factors beyond population. Over the long term, population growth still contributes to the available pool of potential border crossers, thus influencing the number of crossings.

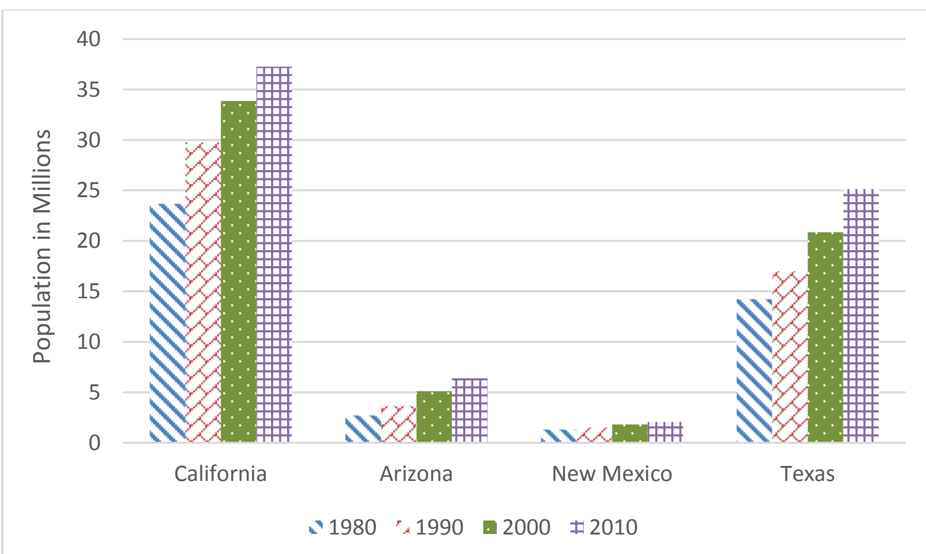


Figure 4-7 US Border State Population US-Mexico Border (1980-2010)
Source: US Census (1980-2010)

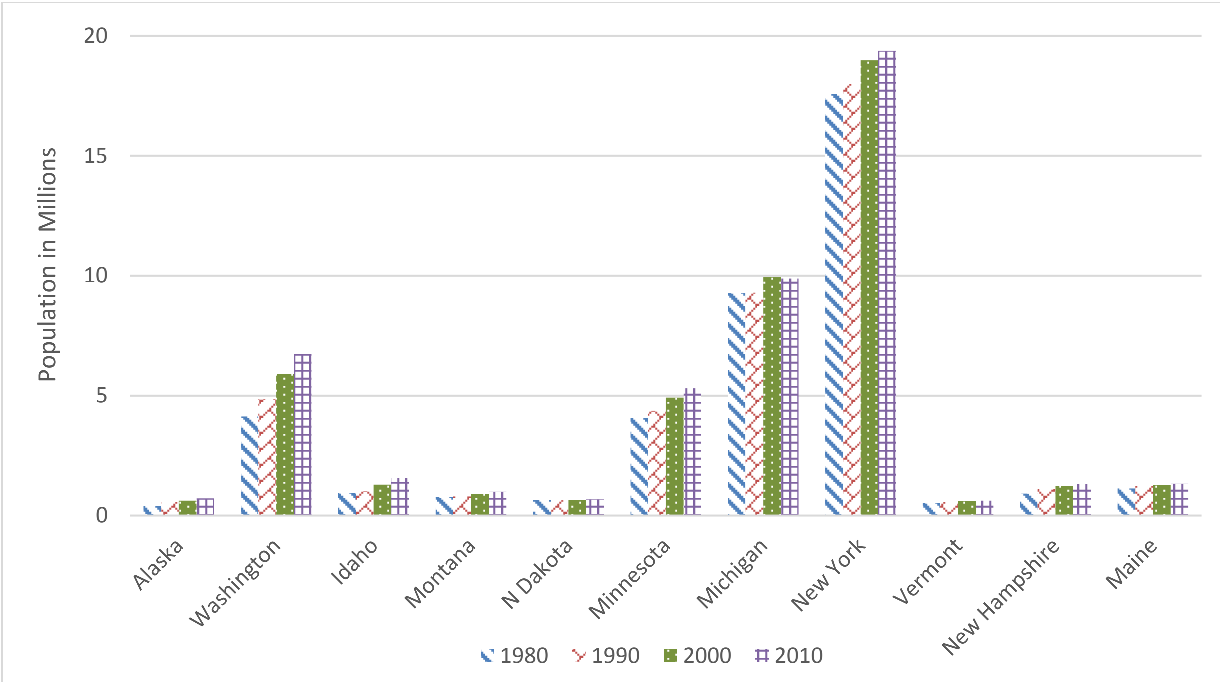


Figure 4-8 US Border State Population US-Canada Border (1980-2010)
Source: US Census (1980-2010)

4.5 US EMPLOYMENT DATA

Employment data for the US was obtained from the Bureau of Labor Statistics. **Figure 4-9** shows the historical trend of employment by states along the US-Mexico Border compared against the national trend of US employment from 1995 to 2015. **Figure 4-10** provides a similar summary of employment for states along the US-Canada border compared against the national trend for the same period.

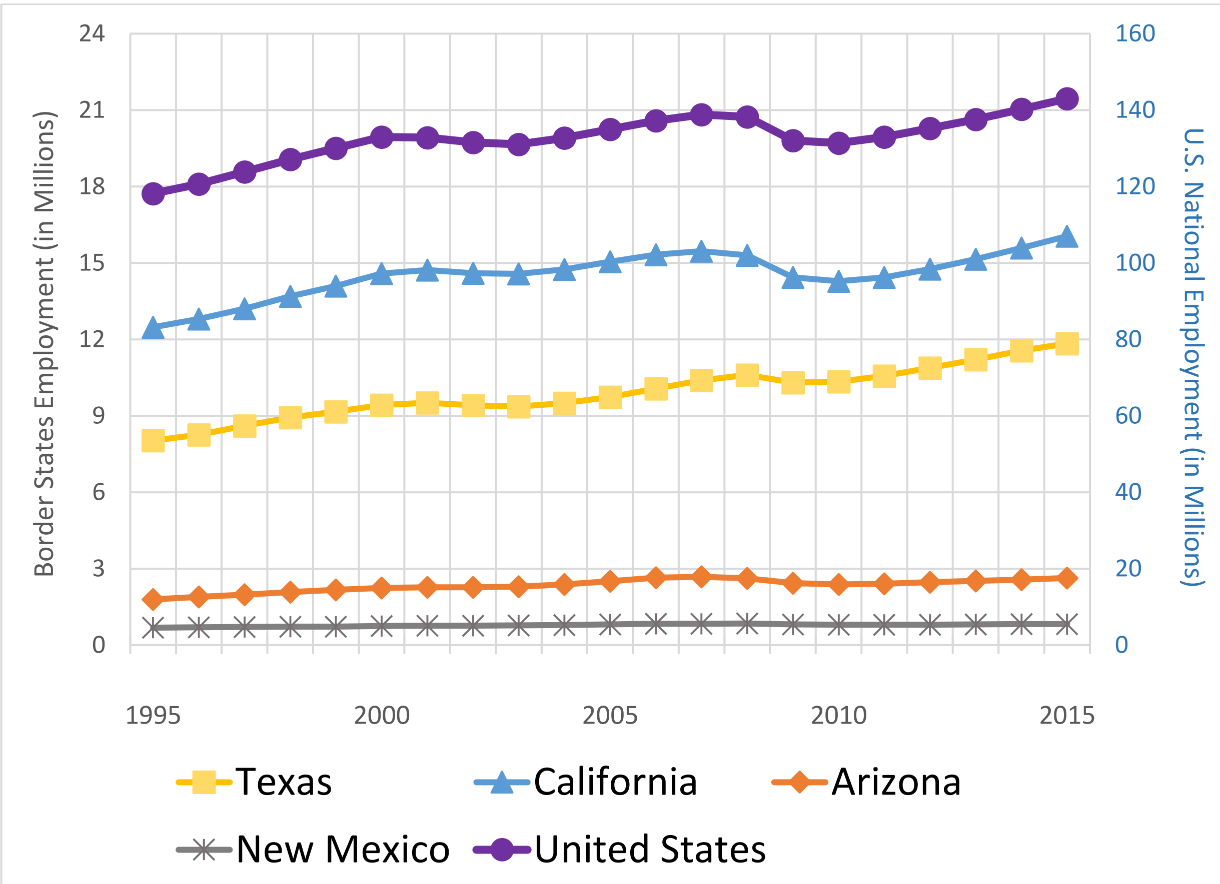


Figure 4-9 Employment in US States along the US-Mexico Border (1995-2015)
Source: Bureau of Labor Statistics

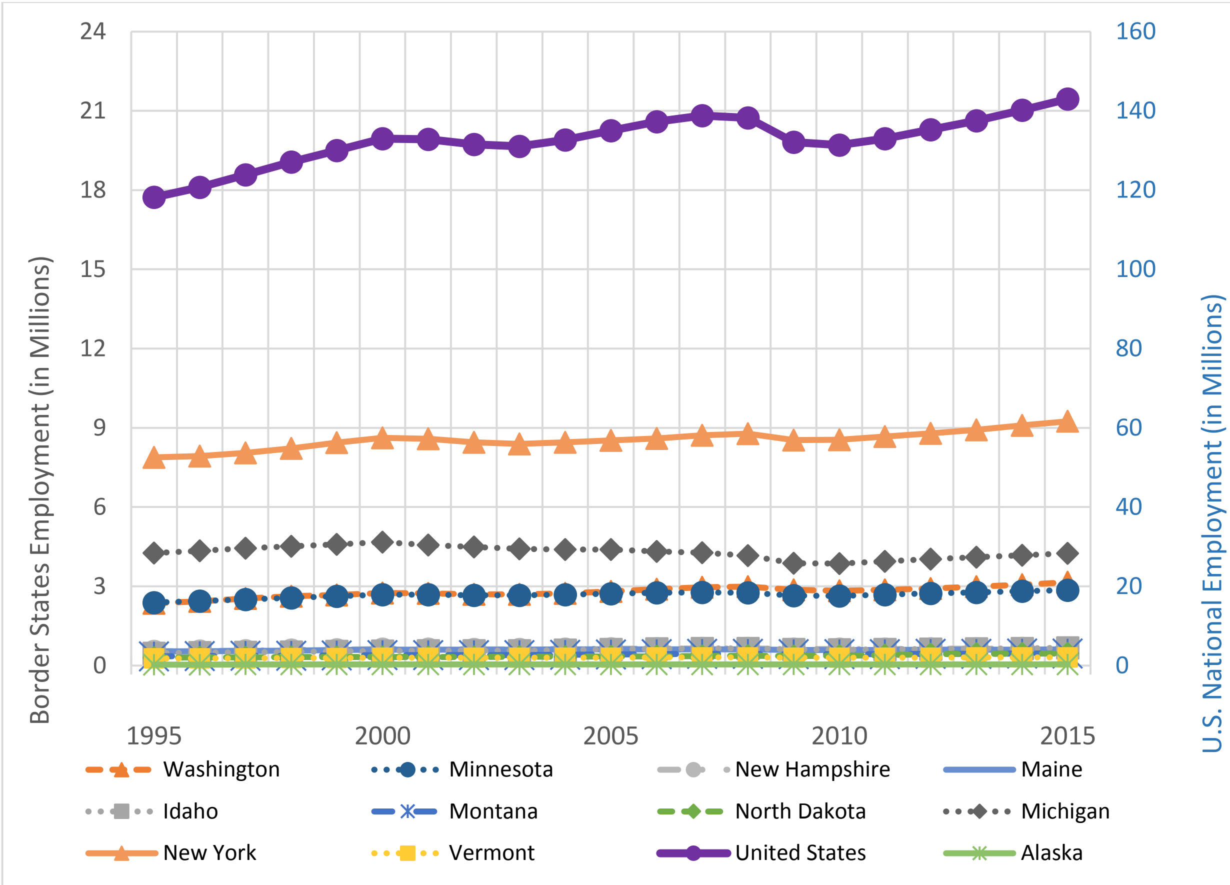


Figure 4-10 Employment in US States along the US-Canada Border (1995-2015)

Source: Bureau of Labor Statistics

The purple line in both graphs shows employment for the US as a whole. The employment data show an increase in employment throughout the late 1990s, which is consistent with the period of economic growth associated with the rise of the new computer-driven economy, commonly referred to as the “tech boom” or the “tech bubble.” In 2001, the trend in employment growth appears to have ended, with employment slightly less than what it had been in the previous year. In 2002, employment continued to decline and by 2003 it reached a low point. By 2004, the trend in job loss reversed itself, and employment across the country increased. The period of lower employment followed the recession of 2001. The period from 2004 to 2007 again shows growth in employment rising above employment in 2000, with the following year showing flat growth to employment in 2008 and sharply declining employment in 2009 and 2010. This period coincides with what has come to be termed the Great Recession. Employment began to increase in 2011, and by 2015 it had exceeded employment in 2007.

This classic business cycle pattern at the national level is reflected in all of the border states. Each state experienced increasing employment growth in the late 1990s followed by loss from the 2001 recession. Furthermore, all states but one – Michigan – saw an increase of employment leading up to the Great Recession.

Michigan never recovered from the 2001 recession. Though employment growth in Michigan had not been dramatic leading up to the 2001 recession, it was observable. Following the recession, Michigan, like the other states along the border, experienced a loss of employment; however, unlike the other states, employment in Michigan continued to decrease after 2002, with another greater loss of employment following the Great Recession. It was only after the Great Recession that employment in Michigan began to increase, although by 2015 employment had yet to reach the levels Michigan had in 2000.

While not exact, there does appear to be some correlation with employment and border crossings. Crossings for both passenger vehicles and freight appear to drop consistently with the two recessions occurring in the period of analysis. The National Bureau of Economic Research has identified that the recession of 2001 began in March of that year; this is the same point at which passenger crossings peaked in **Figure 4-3**. Passenger crossings did not dramatically recover with the employment growth following a recession in the border-states, however, indicating that other factors are at work as well.

Despite this, although population may affect long term changes in border crossings by increasing the pool of potential crossers, it appears that economic health has more influence on the yearly fluctuation in border crossing demand. The relationship between the business cycle and freight crossings appears to be even more direct.

4.6 CANADIAN POPULATION DATA

The Canadian population data was collected at the Census Division level for the period from 1991 through 2011, in five-year increments. For illustrative purposes, the data is aggregated by provinces and shown in **Figure 4-11**. For most provinces, population growth was strong and positive. This growth is strongest in Ontario, followed by Quebec, British Columbia, and Alberta; and it follows the general trend of Canadian populations migrating to the country's larger southern urban areas.

The more rural and/or northern provinces have been experiencing relatively flat, or in some cases negative, growth as the population moves out of those areas. Like with the US, the trend in increased population growth along Canada's border regions does not correlate well with changes to border crossings. This is most apparent in Ontario. Though Ontario is benefitting from ever increasing growth in population, Region 10, which includes Windsor, London, Niagara, and Toronto, shows consistent and dramatic reductions in annual border crossings during the analysis period.

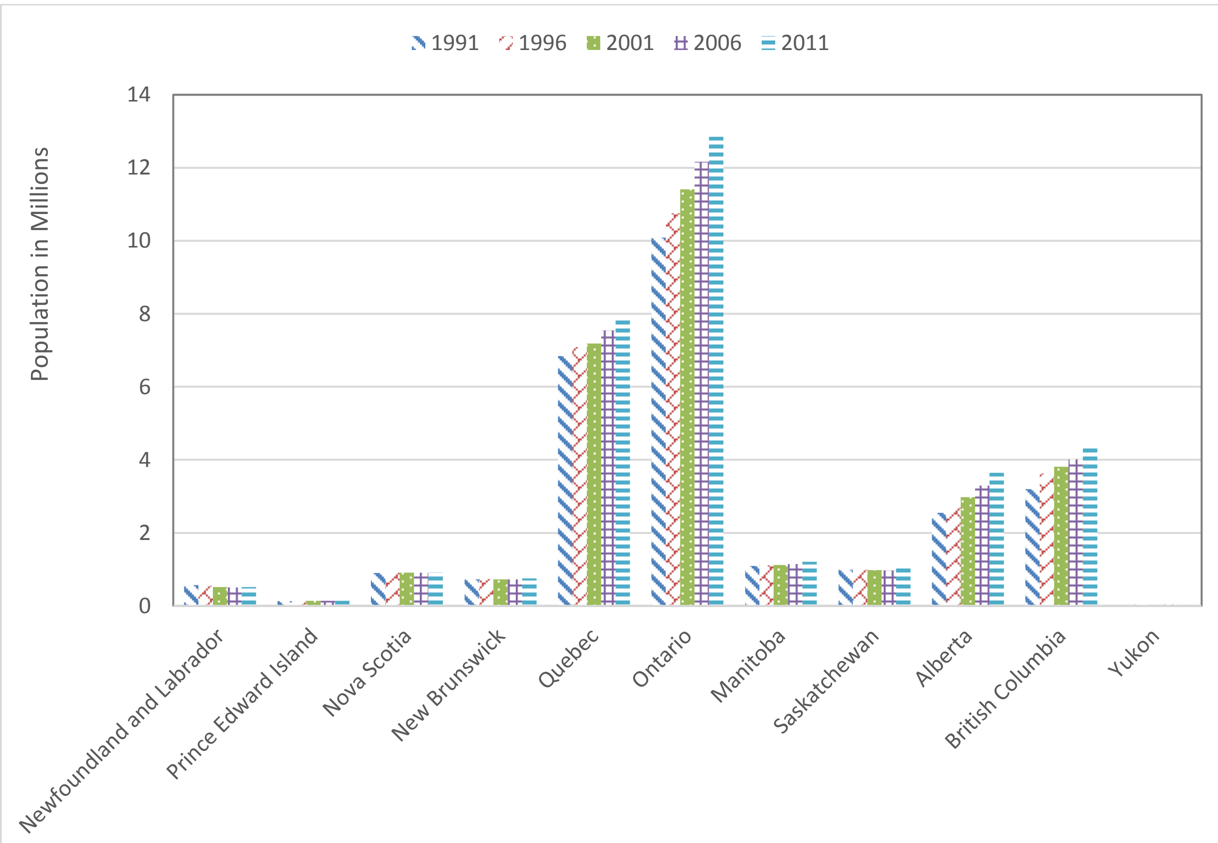


Figure 4-11 Canadian Provinces Population (1991-2011)3
Source: StatsCanada Census of Population (1991 – 2011)

[3] The Yukon population is not zero, but is significantly smaller than the other provinces and does not appear in the graph at this scale.

4.7 CANADIAN EMPLOYMENT DATA

Like the population data, data on employment were collected at the Census Division level and are shown by province in five-year increments from 2001 to 2011 in **Figure 4-12**. Growth in population is consistent between each of the benchmark years, with undramatic and prolonged loss of employment apparent. This general positive trend, much like that of the population data, makes establishing a direct relationship between Canadian employment and border crossings difficult.

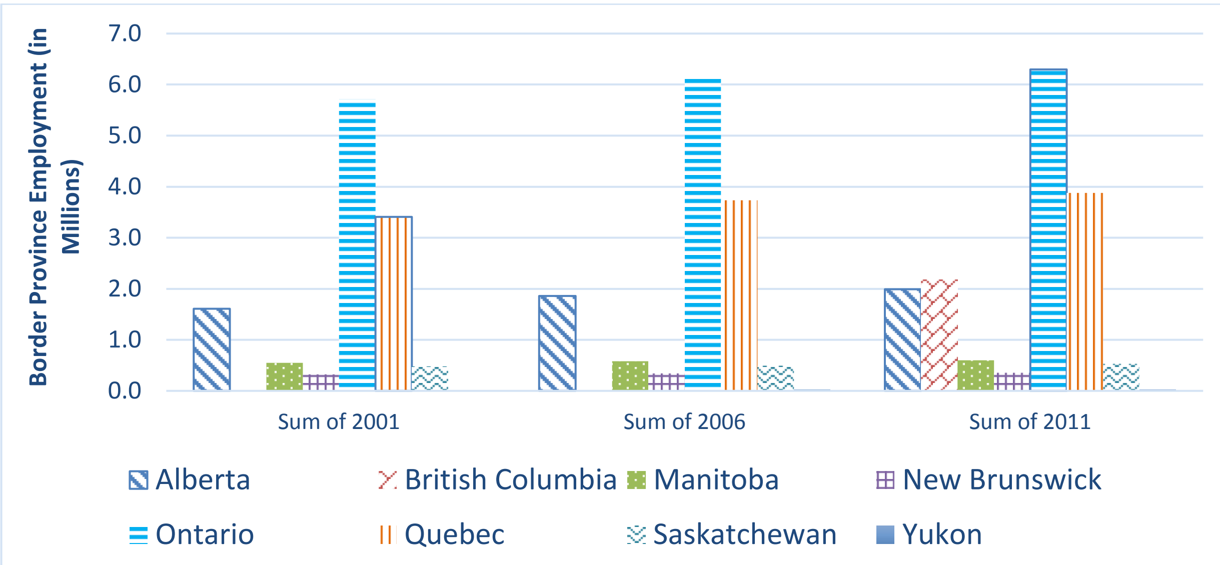


Figure 4-12 Canadian Provinces Employment (2001-2011)4
Source: StatsCanada

[4] The Yukon employment is not zero but is significantly smaller than the other provinces shown here. It does not appear in this graph at this scale.

4.8 MEXICAN POPULATION DATA

Figure 4-13 provides a summary of the population by Mexican states. As with Canada and the US, there is consistent positive growth of population throughout Mexico. This growth in population is contrary to the decreased levels in border crossings observed during the analysis period. The same comments concerning this phenomenon mentioned for the US in **Section 4.4** and for Canada in **Section 4.6** apply here: population growth might be useful for long-term scaling, but is not in itself a sufficient predictor of border crossings.

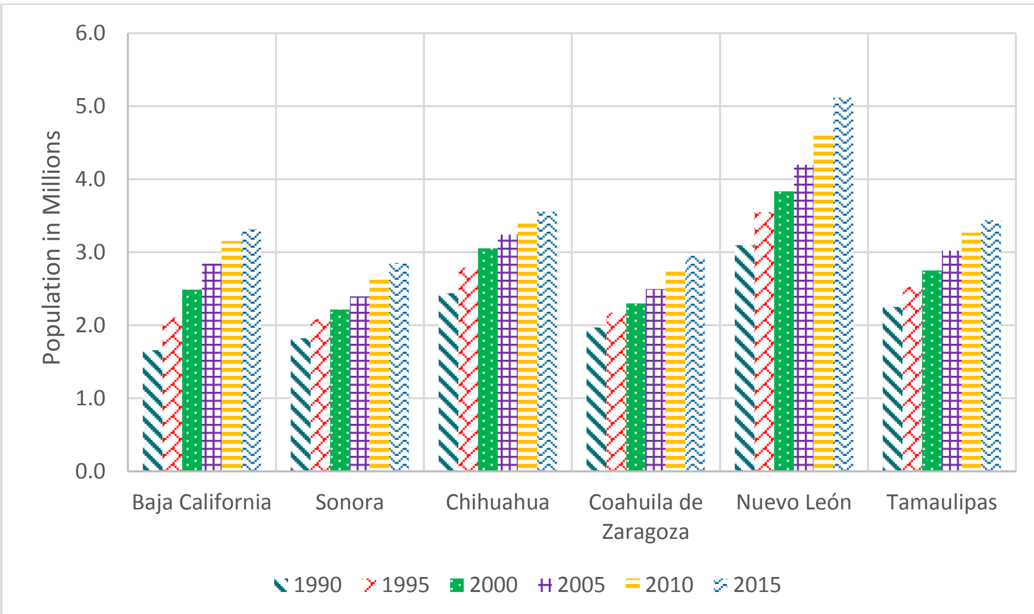


Figure 4-13 Mexican States Population (1990-2015)
Source: Mexican Census (1990 – 2015)

4.9 MEXICAN EMPLOYMENT POPULATION DATA

Relevant employment data was collected for Mexico, as had been done for Canada and the US. This data was collected at the Municipio level and aggregated for states for illustrative purposes. **Figure 4-14** shows the employed Mexican population by state. The biggest limitation of this dataset was that employment data was not reported by the Mexican Census beyond 2008. Thus, it was not possible to note if there were any effects from the Great Recession that could prove to be useful in identifying the relationship between economic health and border crossings. The data show that there was a period of intense job growth throughout Mexico between 2003 and 2008. Although this occurs at a time when border crossings from Mexico into the US were mostly decreasing, as was seen previously in **Figure 4-4**, it does coincide with a period of sustained growth in commercial freight movements across the border.

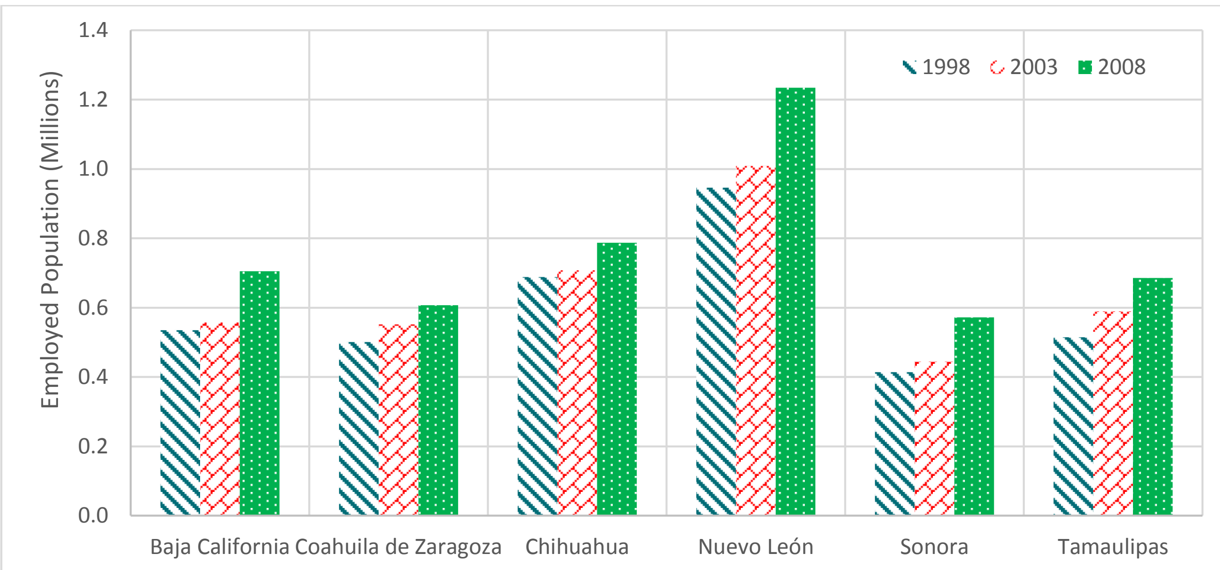


Figure 4-14 Mexican States Employed Population (1998-2008)
Source: Mexican Census (1990 – 2015)

4.10 CURRENCY EXCHANGE RATES

Figure 4-15 shows Canadian and Mexican currency values relative to the US Dollar from 1995-2015. Currency fluctuations may influence border crossings due to the relative strength of each currency when seeking goods and services. For those individuals who are in a position to reside in one country while gaining employment in the neighboring country, differences in salary expectations and currency values might also influence cross-border movements. For example, it could be assumed that more Canadians would enter the US to shop and engage in recreational activities if the Canadian Dollar were stronger than they would if the Canadian Dollar were weaker.

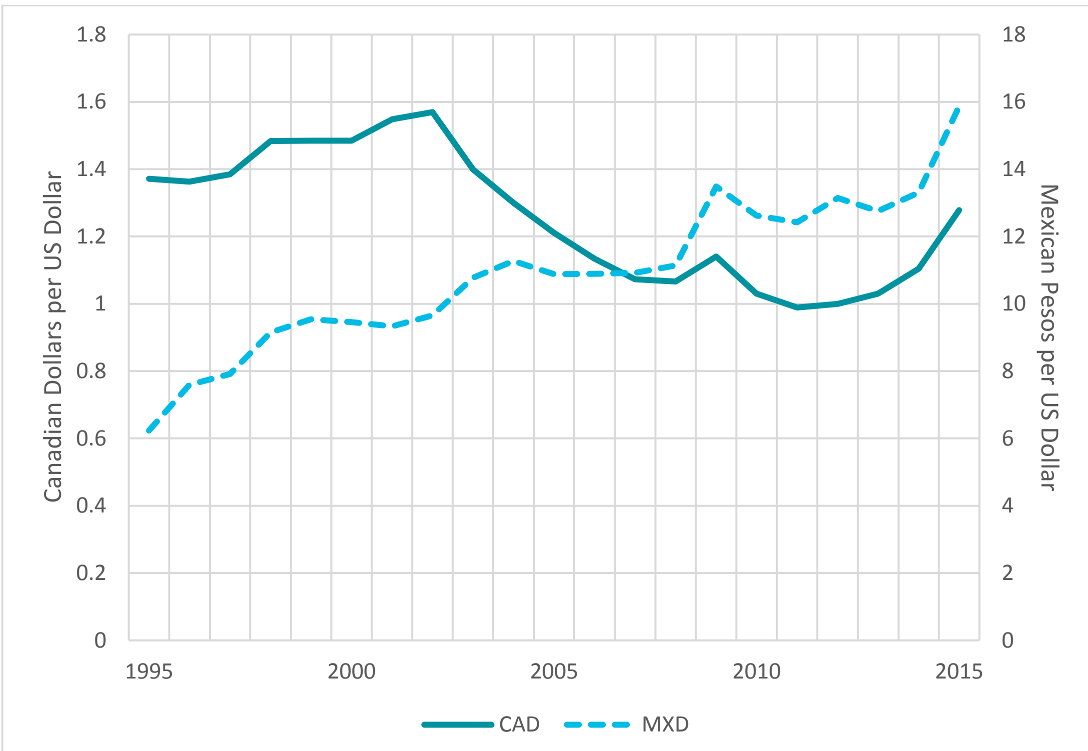


Figure 4-15 Canada and Mexico Currency Exchange Rates (1995-2015)

Source: https://www.oanda.com/currency/historical-rates/

The Canadian Dollar weakened in 1998 and then held fairly steady against the dollar, only gaining very slightly through 2000. In 2001, there was a sudden decrease in the Canadian Dollar's value, followed by another lesser decrease in 2002. This period corresponds to the 2001 recession and its immediate effects. Following 2002, the Canadian Dollar gained ground against the US dollar in the beginning of a trend that would continue through 2008. In 2009, the Canadian dollar experienced another short-lived drop in value, this time in response to the Great Recession. The positive trend reasserted itself the following year and continued to 2011. The Canadian Dollar then decreased in value until 2015. The Mexican Peso weakened against the US Dollar throughout the analysis period to 2015, experiencing only occasional slight increases in value.

4.11 GASOLINE PRICES

Figure 4-16 shows Canadian gasoline prices by border province from 1995-2015 and US gasoline prices by border state from 1995 to 2010. Dashed lines represent U.S. border states. Solid lines represent Canadian provinces. Each line represents a separate state or province. While individual states or provinces are not identified, the separate lines are shown to indicate that there is less price disparity between US Border States than there are between Canadian provinces. All prices are in US Dollars.

The US gasoline prices are consistently lower than Canadian gasoline prices, and the trends in the annual variation of gasoline prices between the two countries parallel one another. The disparity of prices between the US and Canada decreased from 1990 to 2000 and increased once again from 2000 to 2008. The price of fuel can be expected to have an impact on border crossings when combined with other economic indicators. This is because fewer discretionary trips are made when fuel prices are high and economic distress is prevalent.

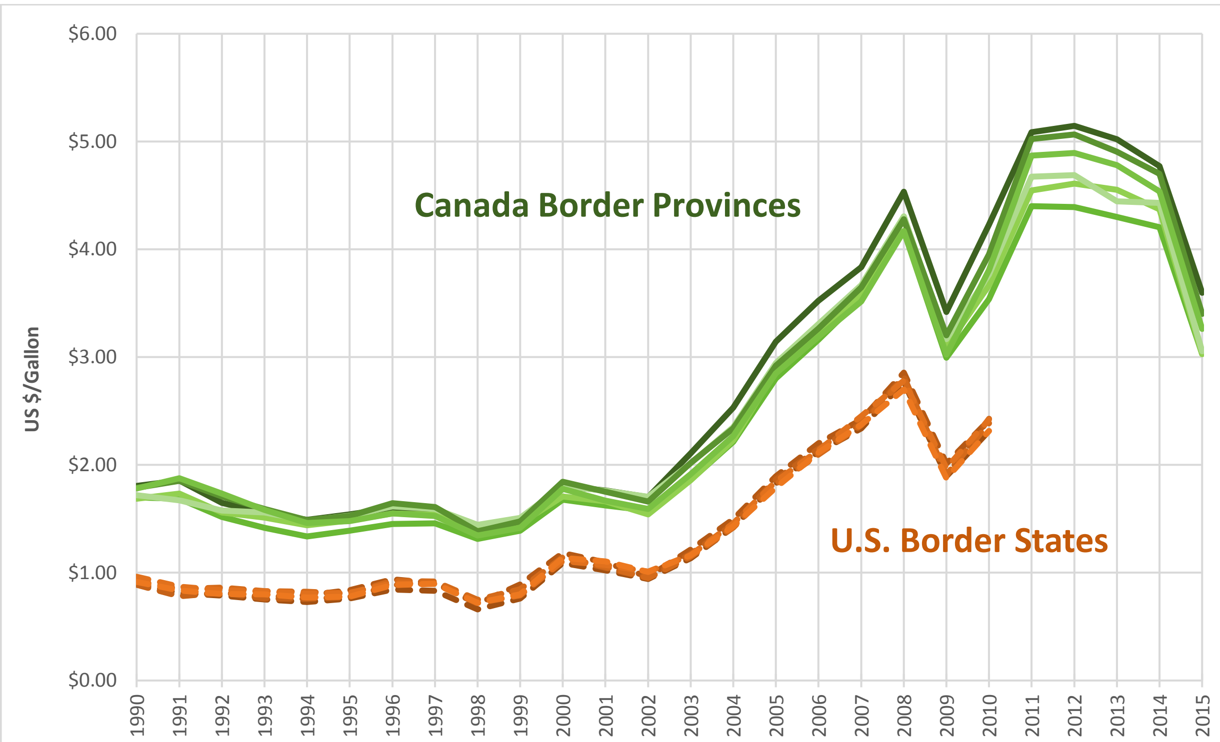


Figure 4-16 Canada and US Gas Prices History (1990-2015)
Source: Energy Information Administration

4.12 GROSS DOMESTIC PRODUCT OVER TIME

Figure 4-17 shows the temporal variation of Gross Domestic Product (GDP) for the US, Canada, and Mexico during the period from 1995-2014. All values have been converted to present 2005 US dollars. To facilitate viewing on one graph, different y-axes have been used for US and Mexico/Canada. GDP growth in all three countries is generally positive, with trends similar to the employment data discussed earlier in **Section 4**. An impact due to the 2001 recession is apparent, as is a more significant impact from the Great Recession.

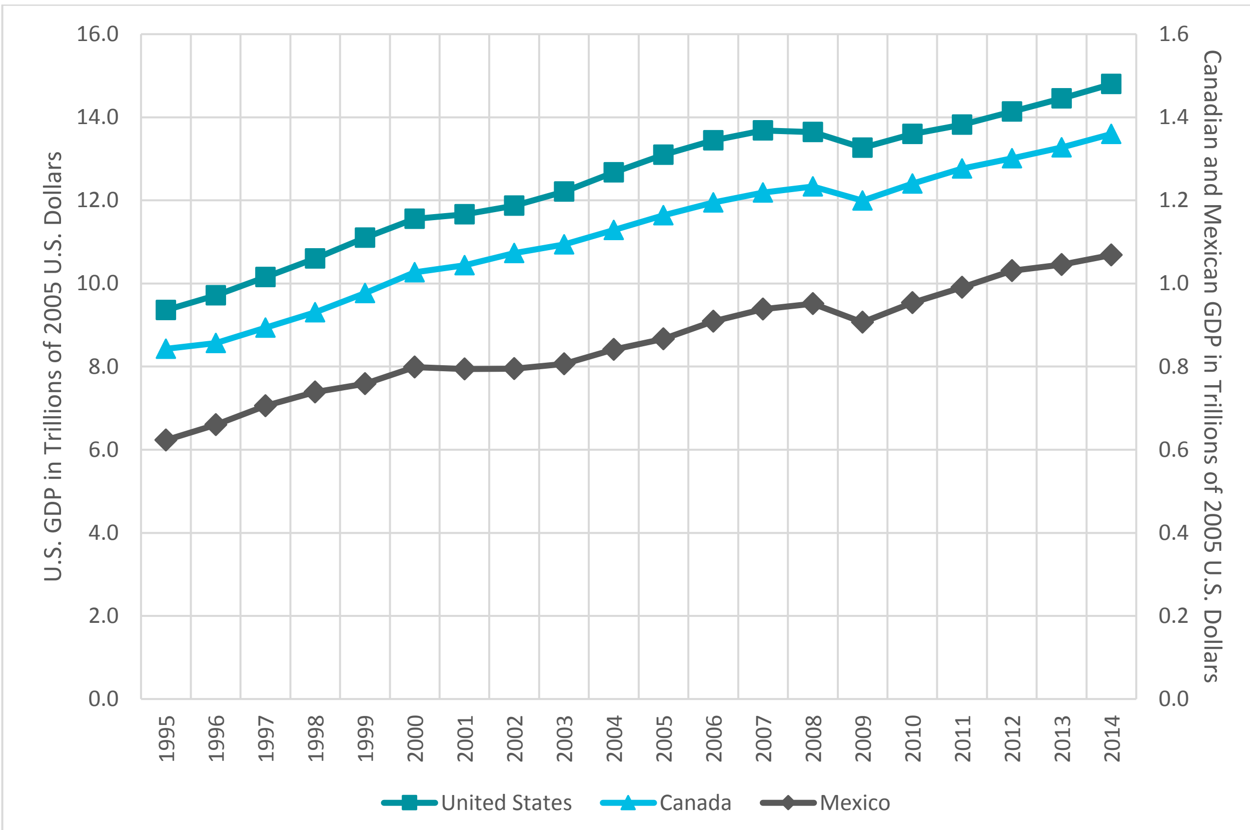


Figure 4-17 Canada, US, and Mexico GDP History (1995-2014)
Source: World Bank Open Data

4.13 UNEMPLOYMENT RATES

Another useful dataset are unemployment rates. **Figure 4-18** shows unemployment data from the World Bank. The unemployment rates for each country are shown by the lines according to the percentages on the left vertical axis of the graph. The bars indicate the ratios of unemployment between Canada the US and between Mexico and the US, and are measured against the ratios indicated on the right vertical axis of the graph. Ratios higher than 1.0 indicate that unemployment was higher in the referenced country than in the US for that year.

The unemployment rate in Canada has historically been higher than in the US, although this changed following the Great Recession when the percentage of the unemployed population in the US exceeded that of Canada. With the exception of a spike in 1995, the unemployment rate in Mexico has been lower than that in the US. Differences in the ways that individual countries report unemployment may account for differences in how these rates compare to one another, but internally consistent standards for reporting within each country should provide a reliable sense of employment increases and decreases from year to year. As such, these data are best used either in a self-referential manner tracking employment within a country from year to year, or as a ratio that can measure the change in unemployment in one country relative to the change in unemployment to another country.

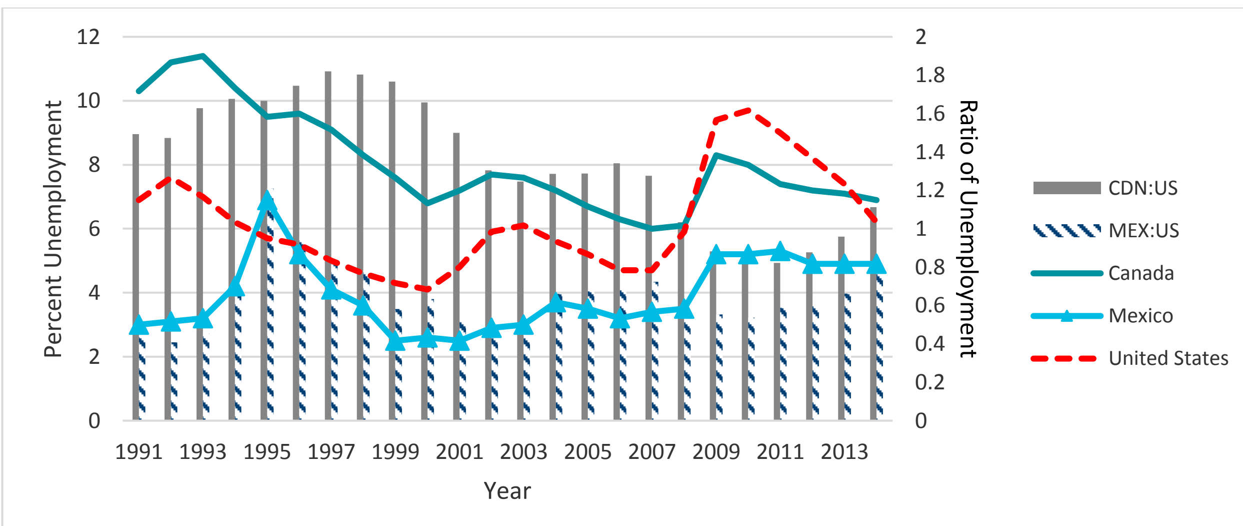


Figure 4-18 Comparison of National Unemployment Rates (1991-2014)

Source: World Bank Open Data

The unemployment rate of Mexico appears to be inversely proportional to the number of passenger crossings along the US-Mexico border, as shown in **Figure 4-19**. The most likely explanation is that as Mexican employment goes down, so does disposable income among Mexican residents, thus reducing the number of discretionary trips to the US.

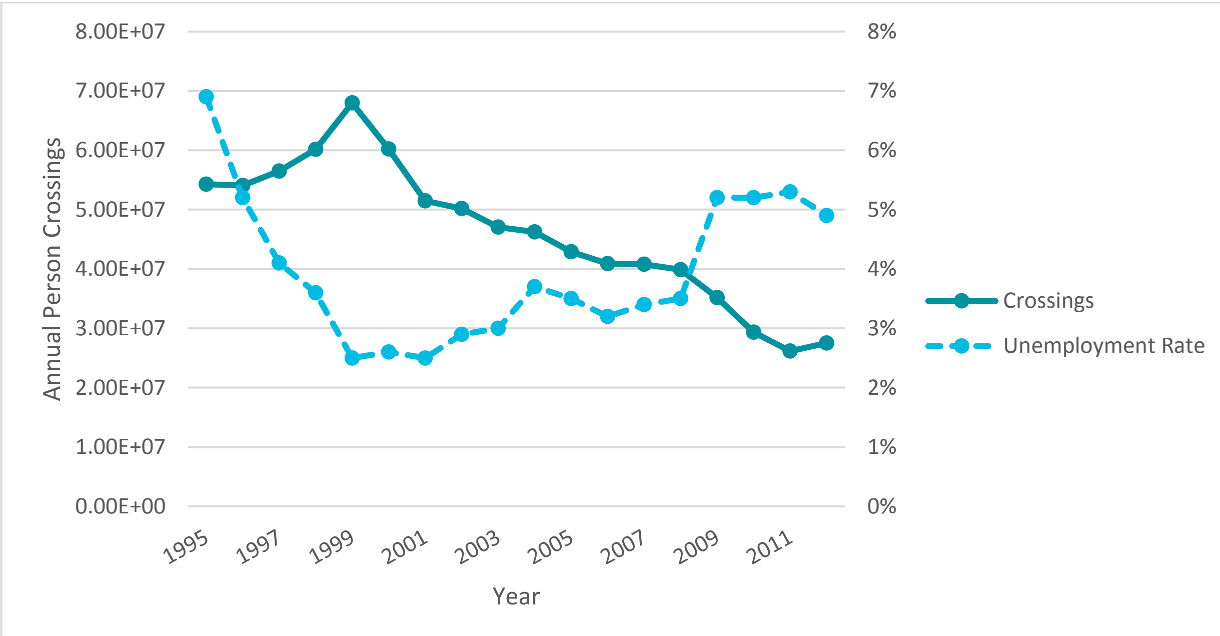


Figure 4-19 Comparison of Mexican Unemployment Rate and US-Mexico Border Crossings (1995-2012)

Source: Unemployment Rate from World Bank Open Data and Crossing Data from BTS Border Crossing/Entry Data

4.13.1 Air Carrier Statistics

The Air Carrier Statistics database, also known as the T-100 database, is a comprehensive databank that contains domestic and international data reported by both U.S. and foreign air carriers on passenger, freight, and mail cargo transported by air, when at least the origin or destination airport is within the U.S. boundaries. The T-100 database can be accessed at the following link:

http://www.transtats.bts.gov/Tables.asp?DB_ID=111&DB_Name=Air%20Carrier%20Statistics%20%28Form%2041%20Traffic%29-%20All%20Carriers&DB_Short_Name=Air%20Carriers

The database provides the following two tables on international flights:

- The **T-100 International Market (All Carriers)** table contains international market data on carrier, origin, and destination for enplaned passengers, freight, and mail when at least one point of service is in the U.S. or one of its territories.
- The **T-100 International Segment (All Carriers)** table contains non-stop segment data on carrier, origin, destination, aircraft type, and service class for transported passengers, freight and mail, available capacity, scheduled departures, departures performed, aircraft hours, and load factor when at least one point of service is in the U.S. or one of its territories.

Figure 4-20 shows the air passenger travel between the US and Canada and between the US and Mexico. **Figure 4-21** shows the air freight travel between the US and Canada and the US and Mexico.

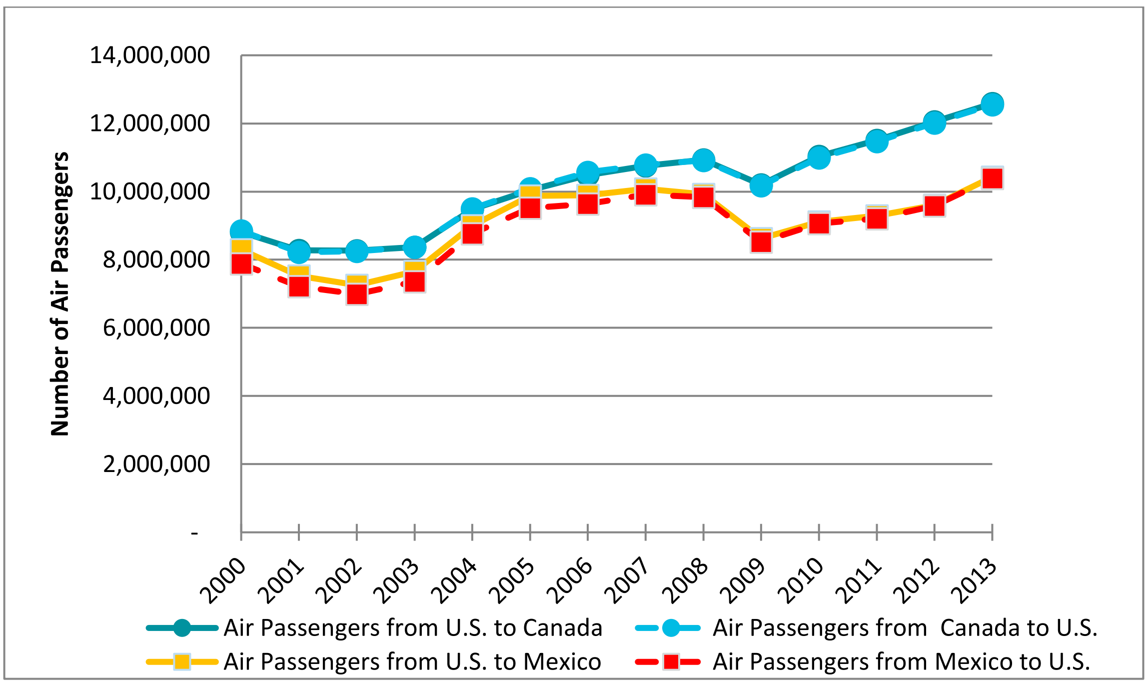


Figure 4-20 Air Passengers between U.S. and Canada, and U.S. and Mexico

Source: Bureau of Transportation Statistics, *Air Carrier Statistics (Form 41 Traffic) - All Carriers, T-100 International Market (All Carriers),* (2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013).

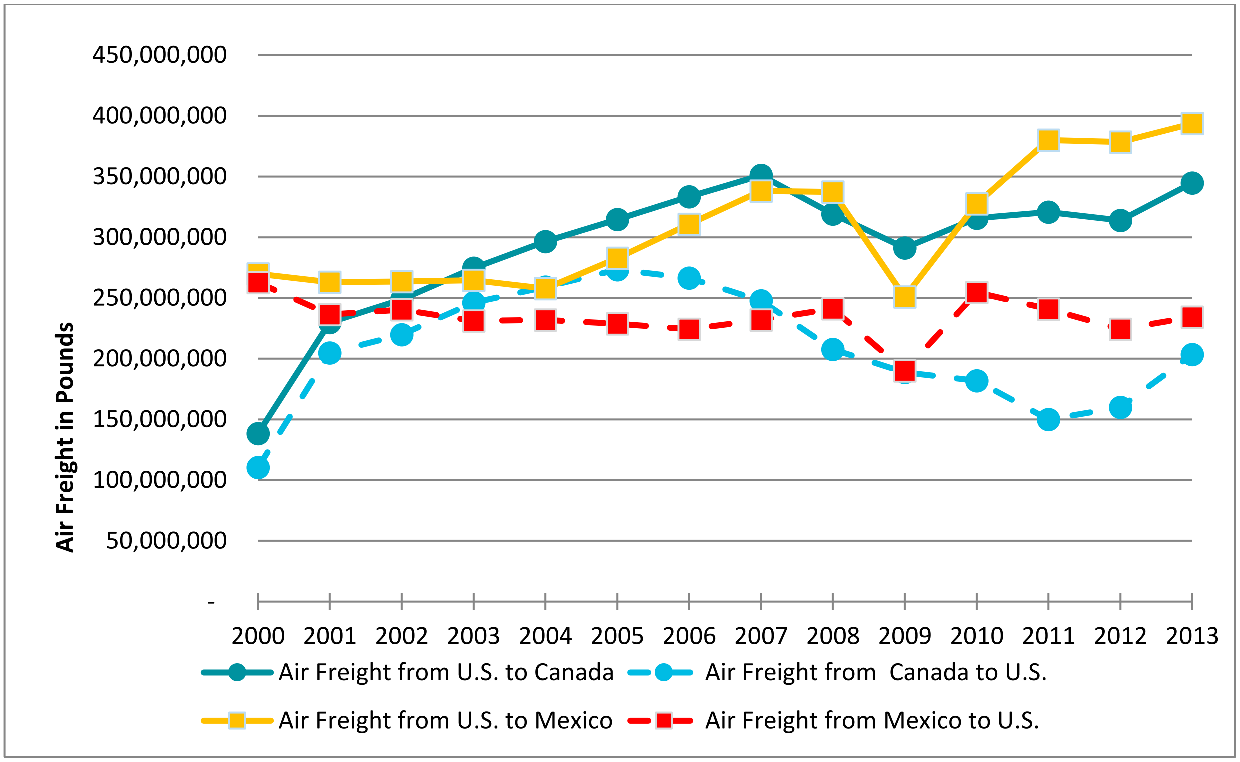


Figure 4-21 Air Freight between U.S. and Canada, and U.S. and Mexico

Source: Bureau of Transportation Statistics, *Air Carrier Statistics (Form 41 Traffic) - All Carriers, T-100 International Market (All Carriers),* (2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013).

4.14 TRUCK AND RAIL

Border crossing data for the US-Mexico border and US-Canadian border also collects information on rail and truck travel. BTS has summarized and organized customs data at the port level. The data reflects the trucks, trains, and containers that have entered the U.S. along the US-Mexican border and US-Canadian border (i.e., inbound movements); the U.S. Customs Service does not collect comparable data on outbound traffic. Data are available for all calendar years, starting in 1996.

Figure 4-22 shows the truck and rail cars entering the US from Mexico. **Figure 4-23** shows the truck and rail cars entering the US from Canada.

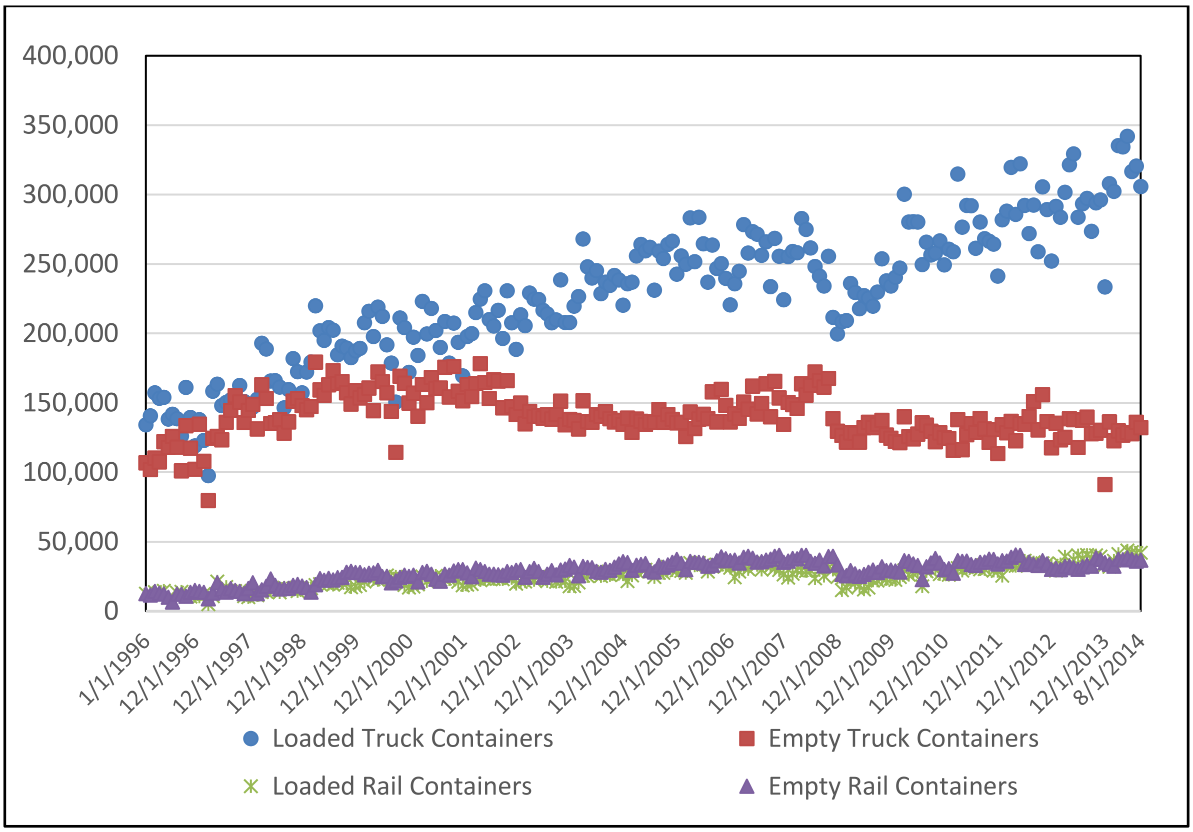


Figure 4-22 Truck and Rail Cars Entering the US from Mexico

Source: Bureau of Transportation Statistics (BTS), *Border Crossing Data.*

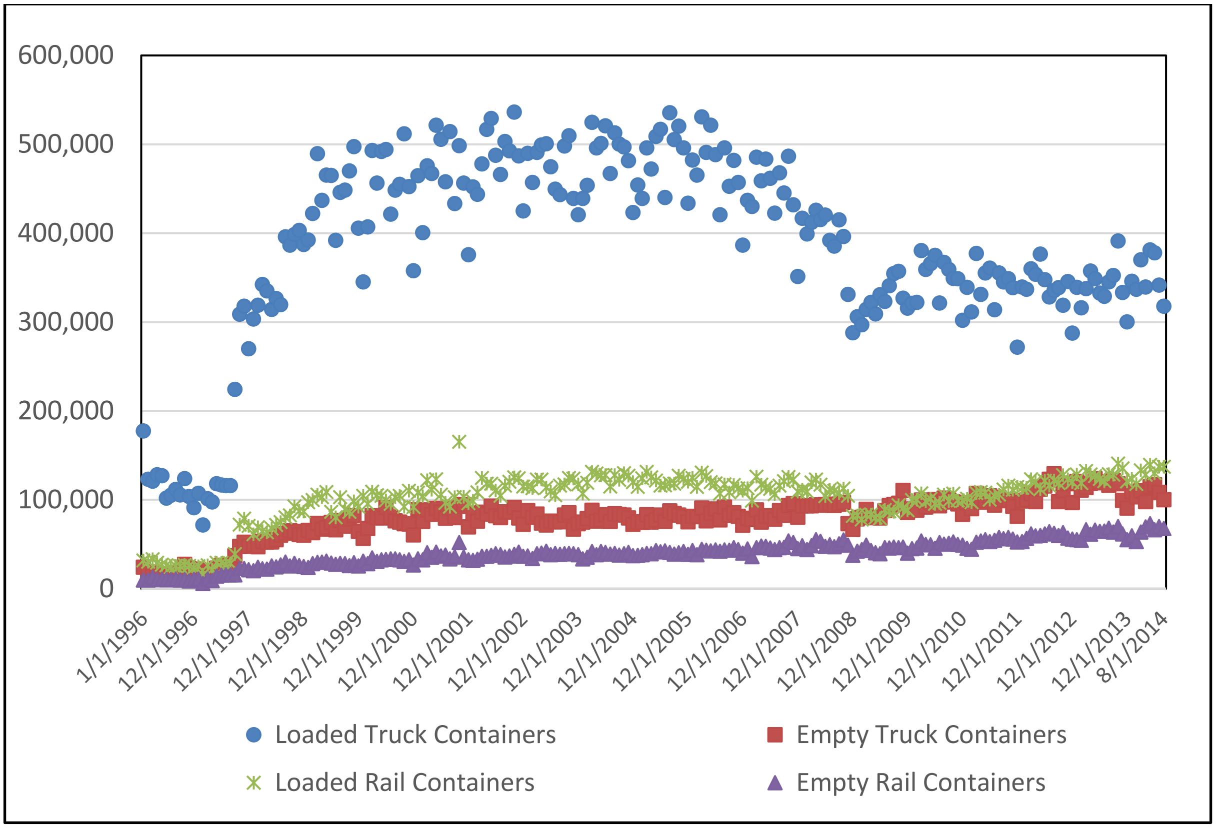


Figure 4-23 Truck and Rail Cars Entering the US from Canada

Source: Bureau of Transportation Statistics (BTS), *Border Crossing Data.*

4.15 DATA SUMMARY

The wealth of data that already exists makes it possible to conduct a border crossing scenario planning study at this scale. The key components for this study rely on having access to historic border crossing/entry data and socioeconomic data, which together can explain the fluctuations in border crossing demand. Though these data were readily available, they tended to exist at aggregate levels of geography: the county, the state/province, the country. This geographic scale accommodates the border region approach detailed later in this study.

Data disaggregated down to the individual traveler were not readily available. Individual traveler surveys of cross border travelers were only available in certain major metropolitan areas. Future investments in border-wide traveler surveys will go a long way in enhancing future iterations of this study.

5. OUTREACH AND DIALOGUE

5.1 OBJECTIVES OF OUTREACH

The current study included extensive outreach efforts to involve stakeholders from all three countries. These efforts were targeted to a wide array of participants, ranging from the public sector to the private sector and from the service industry to representatives of transportation logistics. In terms of implementation, the outreach and dialogue effort comprised:

- First series of workshops in 2015
    - Washington DC, February 24, 2015
    - Ottawa, Canada, March 11, 2015
    - Mexico City, Mexico, March 23, 2015
- Follow-up Webinar, Fall, 2015
- Second and final series of workshops in 2016
    - Ottawa, Canada, June 6, 2016
    - Washington DC, June 8, 2016
    - Mexico City, June 10, 2016

The primary objectives of the first series of workshops included:

- Familiarize the participants with scenario-planning concepts.
- Validate the use of the four scenarios in the range of potential futures.
- Uncover insights on underlying drivers of passenger and freight cross-border flows.
- Gain initial insights on direction and magnitude of passenger and freight flows.

5.2 SPRING 2015 WORKSHOPS

The above objectives were achieved through a presentation by the project team and breakout sessions that included hands-on approaches to each single scenario. For reference purposes, the summary of the Spring 2015 workshops and the presentations are provided in **Appendix-E**.

The general format of the workshops included:

- Initial session of welcome and introductions.
- An overview of scenario planning and the workshop approach.
- Facilitated breakout sessions for each scenario.
- Conclusive discussion and identification of next steps.

The overview of scenario planning was achieved through the discussion of several real world examples where unexpected events altered the outcomes. Further discussion introduced the participants to the key concepts of scenario planning, and then participants were divided into four groups. Each group was assigned one of the scenarios mentioned earlier in **Section 2** of this document and asked to discuss among themselves the anticipated impacts of their scenario to border crossings. Participants were also asked to provide the project team with feedback concerning these participant discussions.

5.2.1 Participants' Feedback

The participants were asked to provide feedback on the following two question related to passenger and freight movement across the US-Canada and US-Mexico borders:

- What are the key drivers of Passenger/freight flow?
- How will this change in the future (in terms of total and by mode)?

Participants were provided with cross-border travel data between the US and Canada and between the US and Mexico, and then asked to provide their estimated changes on a +2 to -2 scale, where +2 represents strong positive growth and -2 represents strong negative growth. The results of these changes were tabulated as a set of composite scores of the average changes per border and scenario, which provided the project team with a better understanding of the anticipated outcomes of the scenario analysis. **Tables 5-1** through **5-4** summarize the feedback for each scenario.

Table 5-1 Passenger Cross-scenario Flow Comparison Canada-US

Scenario	Direction	POV	Bus	Train	Air	Pedestrian	Overall
Naftástique!	CAN to US	1.00	0.50	0.50	0.70	0	0.90
	US to CAN	0.90	0.40	0.50	0.70	0	0.67
One World Order	CAN to US	-1.00	1.00	1.00	-1.00	0.20	-0.30
	US to CAN	-0.80	0.80	1.20	-1.00	0.20	0.65
Global Marketplace	CAN to US	0.50	0.25	0.75	1.00	0.25	0.38
	US to CAN	0.63	0.50	0.88	0.75	-0.13	0.25
Millions of Markets	CAN to US	0.36	0.45	0.45	1.00	-0.09	0.18
	US to CAN	0.00	0.36	0.27	0.90	-0.18	-0.09

Table 5-2 Freight Cross-scenario Flow Comparison Canada-US

Scenario	Direction	Truck	Rail	Air	Maritime	Pipeline	Overall
Naftástique	CAN to US	1.20	1.30	0.30	0.40	1.30	1.30
	US to CAN	1.30	1.00	0.30	0.10	0.40	1.20
One World Order	CAN to US	1.00	1.20	-0.20	0.20	1.60	0.55
	US to CAN	1.00	1.00	-0.20	0.20	0.60	0.35
Global Marketplace	CAN to US	0.88	1.50	0.75	0.88	1.50	0.49
	US to CAN	1.13	1.38	1.00	0.38	0.38	0.63
Millions of Markets	CAN to US	0.55	0.81	0.00	0.18	0.81	0.36
	US to CAN	0.67	0.72	0.00	-0.09	0.27	0.63

Table 5-3 Passenger Cross-scenario Flow Comparison Mexico-US

Passenger Cross Scenario Comparisons (MEXICO – U.S.)							
SCENARIO	**DIRECTION**	**POV**	**BUS**	**TRAIN**	**AIR**	**PEDESTRIAN**	**OVERALL**
Naftástique	MEX to US	1.30	1.20	0.50	0.80	0.20	1.25
	US to MEX	0.60	0.50	1.00	0.10	0	1.00
One World Order	MEX to US	-1.20	1.20	1.00	-1.00	0.80	0.85
	US to MEX	-0.80	0.60	1.00	-1.00	0.60	-0.80
Global Marketplace	MEX to US	1.38	0.75	1.25	1.38	1.00	1.25
	US to MEX	1.38	0.50	0.75	1.38	0.63	0.70
Millions of Markets	MEX to US	0.45	1.00	0.18	1.18	0	0.64
	US to MEX	0.45	0.45	0.09	1.18	-0.09	1.00

Table 5-4 Freight Cross-scenario Flow Comparison Mexico-US

Freight Cross Scenario Comparisons (MEXICO – U.S.)							
SCENARIO	**DIRECTION**	**TRUCK**	**RAIL**	**AIR**	**MARITIME**	**PIPELINE**	**OVERALL**
Naftástique	MEX to US	1.70	1.60	0.70	0.30	0.80	1.70
	US to MEX	1.40	1.20	0.50	0.00	0.50	1.10
One World Order	MEX to US	0.80	1.20	-0.2	0.80	0.80	0.45
	US to MEX	0.80	1.00	-0.2	0.80	0.60	0.55
Global Marketplace	MEX to US	1.50	1.75	0.88	1.13	0.88	1.40
	US to MEX	1.38	1.50	0.88	0.75	0.75	1.30
Millions of Markets	MEX to US	0.90	1.20	0.36	0.36	0.36	0.64
	US to MEX	0.55	0.64	0.09	0.09	0.18	0.72

5.2.2 Conclusions from Feedback

The workshop participants' feedback led to several important conclusions, including the following:

- The four scenarios presented during the workshops were sufficiently distinct, allowing participants to meaningfully describe differences in the impacts to border crossings.
- The participants provided insight into the driving forces behind passenger and freight movements across the borders.
- The ranges of possible impacts on border crossings for each scenario provided a benchmark for later analysis.

A summary of workshop participation is provided in **Tables 5-5** and **5-6**.

Table 5-5 Workshops Attendees by Workshop Dates

Workshop	Invitees	Attendees	Attendance Rate
Feb 24th Workshop with U.S. Stakeholders	300	34	11%
March 11th Workshop with Canadian Stakeholders	250	40	16%
March 23rd Workshop with Mexican Stakeholders	180	63	35%
Overall =	**730**	**137**	**19%**

Table 5-6 Participant Categories by Workshops

Washington DC Participant Category	Attendees	%
U.S. Government	19	56%
U.S./Binational Association	7	21%
U.S. Chamber	2	6%
Air Cargo/Passenger Carrier	2	6%
Freight Rail Carrier	1	3%
Intercity Passenger Motor Carrier	1	3%
Developers/Real Estate	1	3%
Consultant	1	3%
Total =	**34**	**100%**

Ottawa Participant Category	Attendees	%
Canadian Government/Provinces	18	45%
Canadian/Binational Association	11	28%
Bridge Authority	5	13%
Freight Rail Carrier	2	5%
U.S. Government	1	3%
Chamber of Marine Commerce	1	3%
Trade Corridor	1	3%
Academia	1	3%
Total =	**40**	**100%**

Mexico City Participant Category	Attendees	%
Federal/State Mexican Government	29	46%
Mexican Association	16	25%
Manufacturer/Exporter	4	6%
Freight Rail Carrier	3	5%
Mail & Parcel, Cargo Carrier - Domestic & Int.	2	3%
Third Party Logistics (3PL)	2	3%
Consultant	2	3%
Air Cargo and/or Passenger Carrier	1	2%
Intercity Passenger Motor Carrier	1	2%
Development Corporation	1	2%
Maritime Services	1	2%
Distribution Centers Developer	1	2%
Total =	**63**	**100%**

5.3 FALL 2015 WEBINAR

The Fall 2015 webinar served as a follow-up to the Spring 2015 workshops. Webinar attendees included modelers, statisticians, and planners representing cross-border agencies. The Fall webinar also provided information to those who could not attend the Spring 2015 workshops. The primary objectives of the fall webinar were to:

- Review and discuss the proposed scenario planning modeling framework that would be used to forecast future passenger and freight traffic flows across North America.
- Identify opportunities to improve the proposed scenario planning modeling framework.

In addition, the webinar served as an opportunity to**:**

- Familiarize attendees with the Scenario Planning Project.
- Describe and discuss the benefits of incorporating the proposed modeling framework into transportation and cross-border planning decisions.
- Understand how and where to use the scenario planning modeling framework.
- Obtain attendees' buy-in on the scenario planning modeling framework.

The webinar presentation is provided in **Appendix-F** of this document.

5.4 SPRING 2016 WORKSHOPS

As a final step in the outreach process, a second series of workshops were held in June 2016, when most of the analytical work was nearing completion. These workshops focused on the results of the scenario-based analysis, and the purpose was to obtain additional feedback and/or comments on the completed work and to finalize the results accordingly. The comments/questions provided by the participants were addressed during the meeting and recorded in the meeting notes. An English version of the presentation was given in Ottawa and Washington D.C.; the Ottawa presentation was further supplemented in French for the benefit of francophone participants. A Spanish version of the material was presented in Mexico City. **Appendix-G** contains the presentation material and notes from all three workshops.

5.4.1 Workshop participation

As shown in **Tables 5-7** and **5-8**, more than 240 individuals were invited to participate in the Ottawa workshop. Invitees that did not respond by an initial registration deadline were individually contacted by phone or email to encourage their participation. A total of 42 RSVP's were received and 32 people attended the workshop. Of the 32, 17 attended in person and 15 attended via teleconference.

More than 101 individuals were invited to participate in the Washington D.C. workshop; a total of 42 RSVP's were received and 23 people attended the workshop. Of the 23, 10 attended in person and 13 attended via teleconference.

More than 291 participants were invited to participate in the Mexico City workshop. A total of 39 RSVP's were received, with 24 people attending the workshop. Of the 24, 19 attended in person and 5 attended via teleconference.

5.4.2 Participant's Feedback

The participants' feedback in the final series of workshops was oriented toward the applicability of the study's analysis to actual planning situations. The project team emphasized the importance of the scenario planning concepts, and explained that the objective of scenario planning is to consider uncertainty through the identification of a range of situations that may result from unanticipated factors typically neglected in a traditional planning study. Detailed information on participant's feedback is provided in **Appendix-G,** as mentioned earlier.

5.4.3 Conclusions from Feedback

The final series of workshops provided valuable feedback at advanced stages of the current study. Important conclusions based upon the feedback include:

- The participants were in agreement with the overall approach adopted by the project team. No specific comments were received that indicated any concerns over the approach.
- The participants showed interest in the availability of the visualization system as a product of the current study.
- Some participants also indicated the utility of some datasets shared with the workshop attendees.
- Participants also indicated an interest in the availability of the final report of this study.

The participant feedback was useful in identifying aspects of the study that were likely to be of greater interest to a general audience. This helped to shape the overall structure of this report as well as the visualization system.

6. METHODOLOGY AND APPROACH

6.1 OVERALL APPROACH

This section of the current document provides details of the overall technical approach adopted by the project team to achieve the project objectives. Prior explaining the methodology and approach, it is necessary to clearly establish the four scenarios identified for this study, which were initially mentioned in **Section 2.3** of the current document. The following sections are intended to provide detailed information about each scenario.

To better understanding of the overall context and application of scenario descriptions in this study and the methodology presented later in this document, it is important to consider the following:

- The four scenarios identified for this study are based on the *NCHRP Report 750 Vol 1*, titled, "Strategic Issues facing Transportation: Scenario Planning for Freight Transportation Infrastructure Investment."

- The above research was primarily focused on freight transportation, and has been applied to passenger transportation as well for the current study. Additional detail on modes also needed to be considered in this study.

- Detailed attributes of each scenario are based on the literature developed by MIT Center for Transportation and Logistics.

- Each scenario is a hypothetical situation intended as an example of future situation as a result of multiple events.

- Scenarios are to be considered mutually exclusive and having an equal probability of occurrence.

Information about each scenario in the following pages is provided with two approaches. Firstly, the scenario is accompanied by a brief definition followed by a series of bulleted explanations. Secondly, important (hypothetical) attributes are quantified using graphs and other illustrations.

The overall analytical approach in this study differed between passenger and freight analyses, as both had varying types of information as starting points. Passenger analyses involved the development of econometric models, whereas the freight analyses benefited from the availability of FAF4 as a starting point.

The first step in the approach was the use of the various observed data sets explained in **Section 4** of this document. After the cleanup and normalization of data, the data were subjected to statistical analyses in order to identify major factors affecting border crossings, marked by strong correlations. The next step was the development of macroeconomic models using the factors identified earlier.

Once the macroeconomic models were completed, scenario assumptions were developed and incorporated into each model, leading to scenario-specific passenger forecasts. Border crossing data from BTS was available by passenger mode, and this information was incorporated in the analysis.

The freight approach used the latest FAF4 database as a starting point. The scenario assumptions derived from scenario descriptions were incorporated into the FAF model to estimate the trips crossing the borders, which were then associated with cross-border origins and destinations on both the Canadian and Mexican side. A separate FAF derived database was developed for each scenario. The FAF already provides freight commodity flows by mode of transport. More details on the freight analysis for this project are provided in **Section 6.7.**

6.2 SCENARIO DESCRIPTIONS

The four scenarios from *NCHRP 750* were presented to stakeholders at the three aforementioned outreach and public involvement workshops in Washington D.C., Ottawa, and Mexico City in February and March of 2015. Over the course of a year, MIT's CTL developed the four scenarios through a series of focused expert panel sessions, practitioner acid testing, and industry-wide surveys. The scenarios were used to illustrate and describe the benefits of scenario planning as a tool to be used in conjunction with other planning methods for improvements in long-range transportation infrastructure planning.

During the outreach activities, participants representing public and private interests in the United States, Canada, and Mexico were familiarized with the concept of scenario planning. Stakeholders assessed the suitability of the four scenarios for use in this study in terms of passenger and freight futures, and offered insights into the underlying drivers – as well as the direction and magnitude of passenger and freight cross-border flows – in North America for each of the proposed scenarios.

6.2.1 Naftástique

The Naftástique scenario entails a future in which Canada, Mexico, and the US form a unified bloc similar to the European Union. In this future, the barriers to trade and migration are lifted, allowing the completely unrestricted movement of goods and services across the three countries. Residents of these countries will have the right to work and reside anywhere that they choose within the bloc. The communities along the borders are expected to become even more culturally and economically integrated than they are today. Highlights include:

- US, Canada, and Mexico form NAMEC (North American Economic Community).
- People and goods move freely between the United States, Canada, and Mexico.
- People live, work, and retire anywhere within bloc.
- NAMEC is energy independent.
- Manufacturing has returned to NAMEC.
- Currency prices are stable within and across blocs.
- Energy prices are high but stable.
- Society and businesses are environmentally conscious.

- Political regulations are strong; they have created blocs but seek to facilitate free flow within the blocs.

Some major attributes of this scenario are illustrated in **Figures 6-1** through **6-3**, which are from the Scenario Brochure titled “Snapshot of the World 2037 Naftástique, by MIT Center for Transportation & Logistics.”

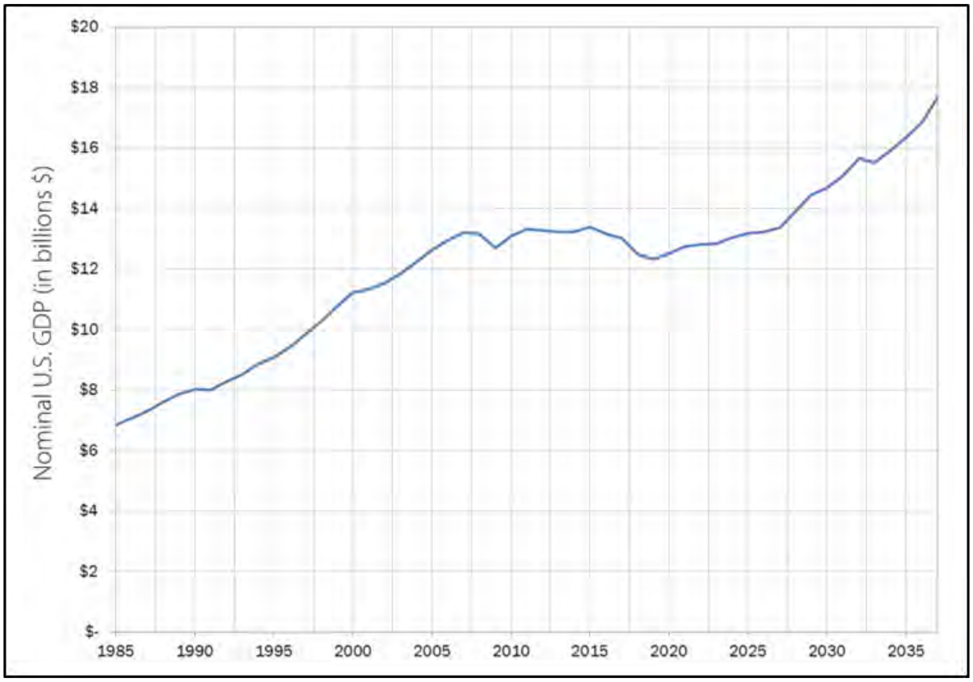


Figure 6-1 US GDP under the Naftástique Scenario

Source: Snapshot of the World 2037: Naftástique scenario brochure

Figure 6-2 Global Per Capita Energy Consumption under the Naftástique Scenario

Source: Snapshot of the World 2037: Naftástique scenario brochure

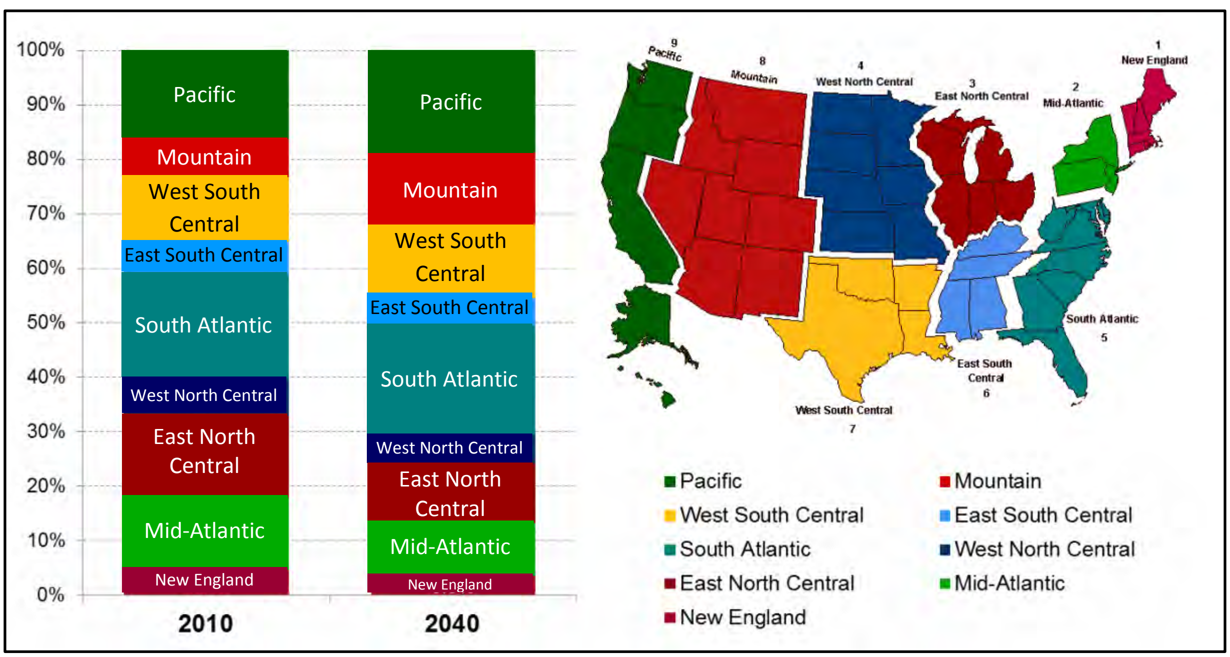


Figure 6-3 Dispersion of the US Population under the Naftástique Scenario

Source: Snapshot of the World 2037: Naftástique scenario brochure

6.2.2 Global Marketplace

The Global Marketplace scenario entails a future where global trade, communications, and travel have accelerated. People are increasingly drawn to larger metropolitan areas where the connections between global trade centers are more easily achieved, and these growing urban densities make use of existing and emerging infrastructure. This dynamic environment stimulates significant socioeconomic growth in key localities. Highlights include:

- Significant global trade that involves most countries, with high levels of collaboration across nations.
- Very high volatility in the supply of goods, currency values, and commodity prices.
- High level of virtual trade (such as e-commerce and digital products).
- Supply chains are very versatile and reasonable in cost.
- Energy is cheap and plenty, yet prices are highly volatile.
- For most large companies, global manufacturing footprints are distributed around the world.
- People prefer to live in large and dense cities; mega-cities are fast-growing.
- Global companies achieve and leverage economies of scale.
- Governmental regulations exist primarily to support global trade.

Some major attributes of this scenario are illustrated in **Figures 6-4** and **6-5**, which are from the Scenario Brochure titled “Snapshot of the World 2037 Global Marketplace, by MIT Center for Transportation & Logistics.” **Figure 6-4** shows the snapshot of US Gross Domestic Product (GDP) through the year 2037 under the Global Marketplace scenario, and **Figure 6-5** shows the variations in global per capita energy consumption for the same time period.

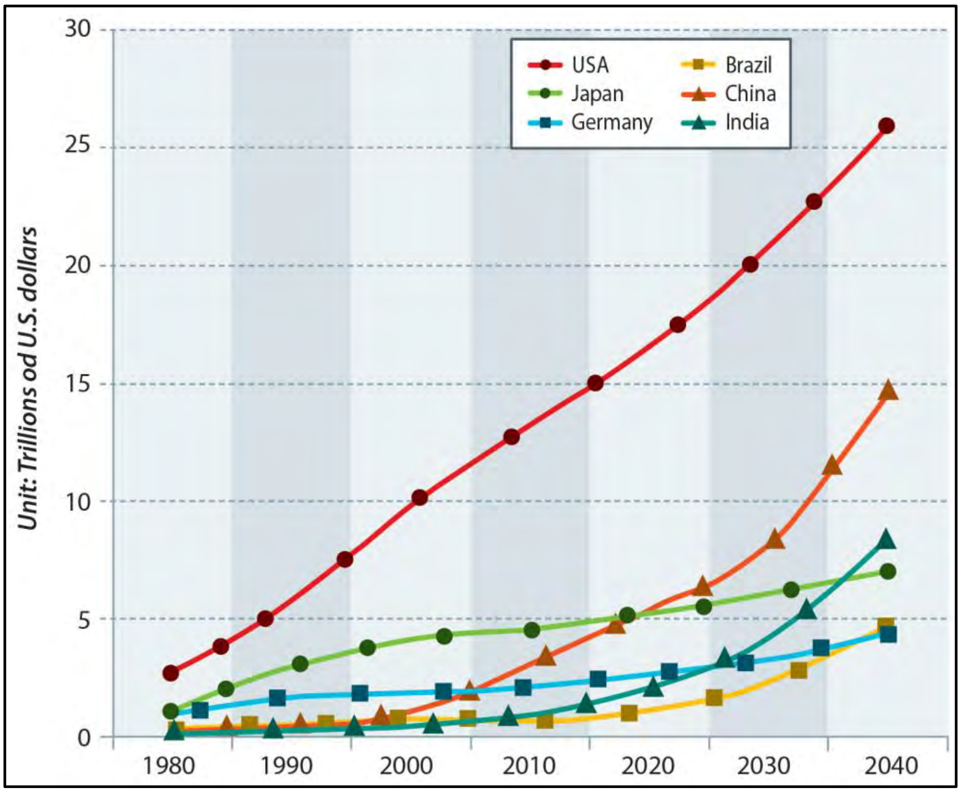


Figure 6-4 GDP of Major Global Economies under the Global Marketplace Scenario

Source: Snapshot of the World 2037: Global Marketplace scenario brochure

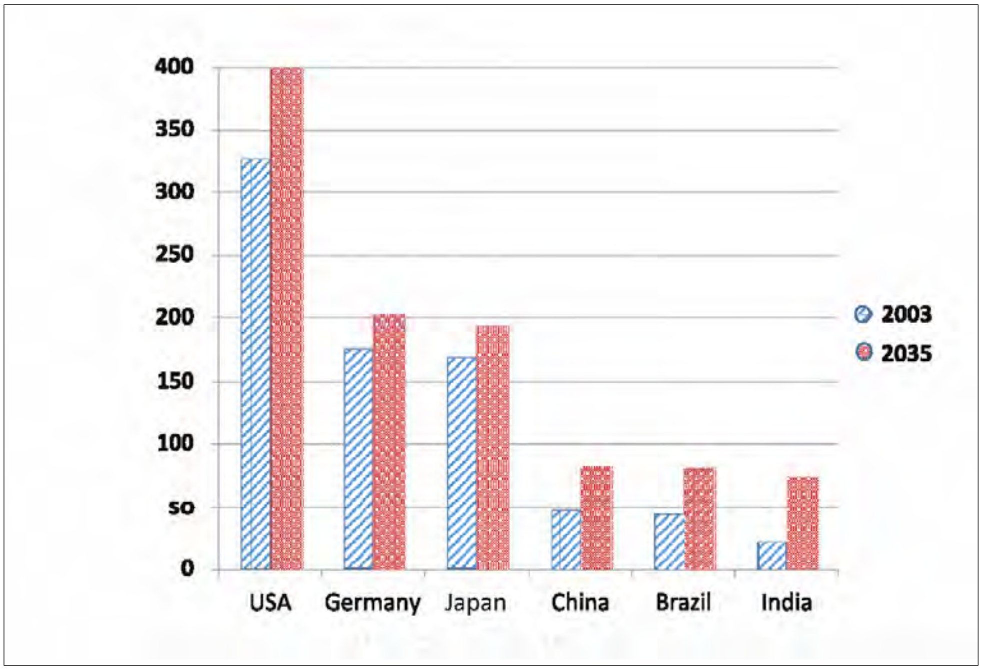


Figure 6-5 Per Capita Energy Consumption under the Global Marketplace Scenario

Source: Snapshot of the World 2037: Global Marketplace scenario brochure

6.2.3 One World Order

The One World Order scenario entails a future where resources are scarce and regulation is high. The movement of goods and people, while possible, is hampered by the governments' need to control the allocation of resources. Travel becomes more expensive and less desirable. Key features of this scenario include:

- Vital resources — energy, water, minerals, etc. — are scarce.
- Governments have created the World Sustainable Trade Organization (WSTO).
- Global trade has transformed into an ordered, less volatile, and more predictable process.
- Although the invisible hand of the market still decides 'what' and 'where' to produce, the visible hand of regulation dictates 'how'.
- Firms have adapted to a highly regulated environment.
- The objective of the WSTO regulations is to achieve a long-term global solution, not short-term firm profits.
- Cities grow bigger, yet the per-capita environmental impact decreases.
- Governments discourage the home delivery of small/cheap packages through taxes and fees.

- Consolidation centers emerge in cities to aggregate deliveries.
- Manufacturers have created large-scale production clusters and ultra-efficient supply chains.

Additional attributes of this scenario are explained below in **Figures 6-6** and **6-7**, which are from the Scenario Brochure titled "Snapshot of the World 2037 One World Order, by MIT Center for Transportation & Logistics."

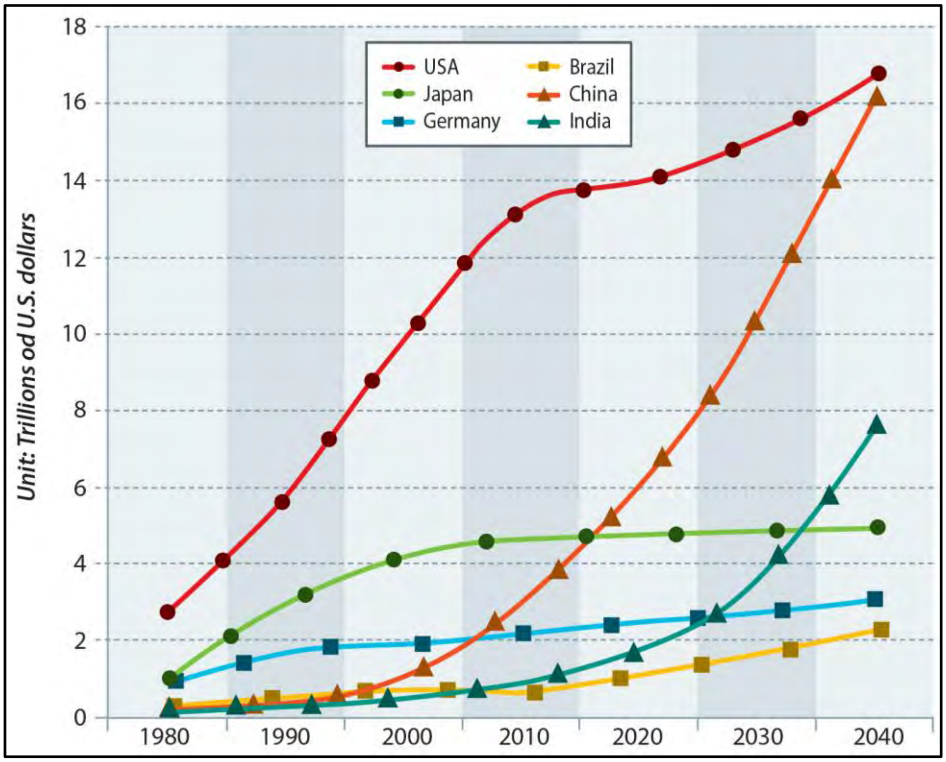


Figure 6-6 GDP of Major Global Economies under the One World Order Scenario

Source: Snapshot of the World 2037: One World Order scenario brochure

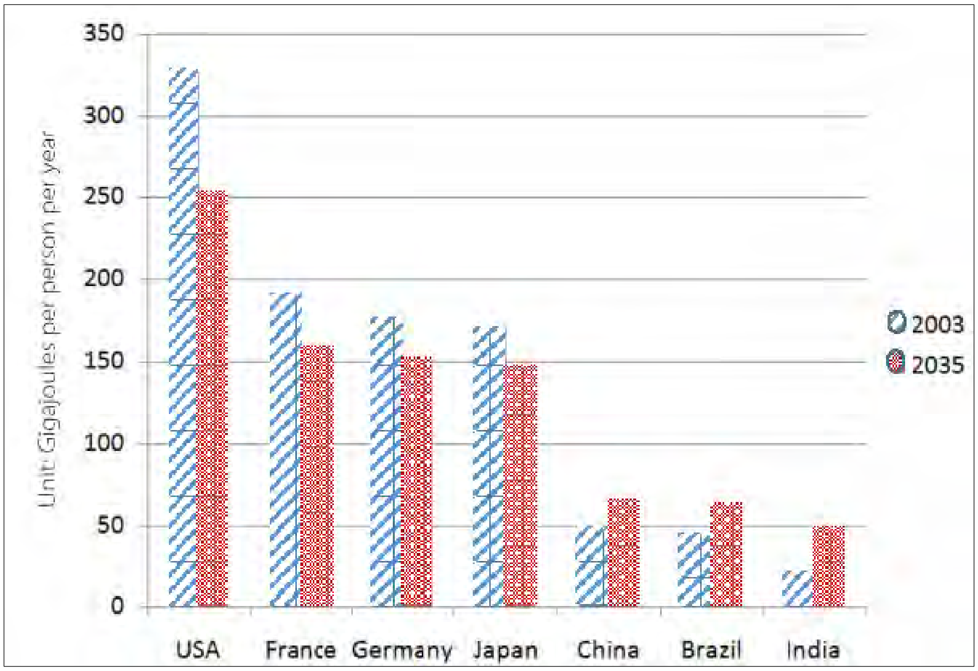


Figure 6-7 Per Capita Energy Consumption under the One World Order Scenario

Source: Snapshot of the World 2037: One World Order scenario brochure

6.2.4 Millions of Markets

The Millions of Markets scenario entails a future where trade and manufacturing are much more localized. As the need to congregate for trade and interaction decreases, population patterns become more decentralized. Local economies that are situated to produce for local demand experience a slight resurgence. Though external pressures suppressing travel are not very strong, the population is more inward-looking and less interested in a hectic, rapid-paced highly integrated world. Highlights include:

- The world has transformed into many self-sufficient clusters of countries and regions.
- Population is dispersed, with the greatest population growth occurring in mid-sized cities.
- The U.S. is energy independent, mainly through natural gas and nuclear energy.
- Technology allows materials to be maintained in their raw forms until needed for production.
- Markets are mostly regional, with demand being met by local supply.
- Technological innovations have lowered economies of scale so that customized production in small batches is economically sound.
- Supply chains primarily carry undifferentiated/raw materials for long distance and differentiated goods for short distances. Undifferentiated materials need not be cheap.

- People reuse & recycle, with technology enabling better recapture of the raw materials.
- Regional governments compete to make their region attractive for businesses investments.

Some major implications of this scenario are illustrated in **Figures 6-8** through **6-10**, which are from the Scenario Brochure titled "Snapshot of the World 2037 Millions of Markets, by MIT Center for Transportation & Logistics."

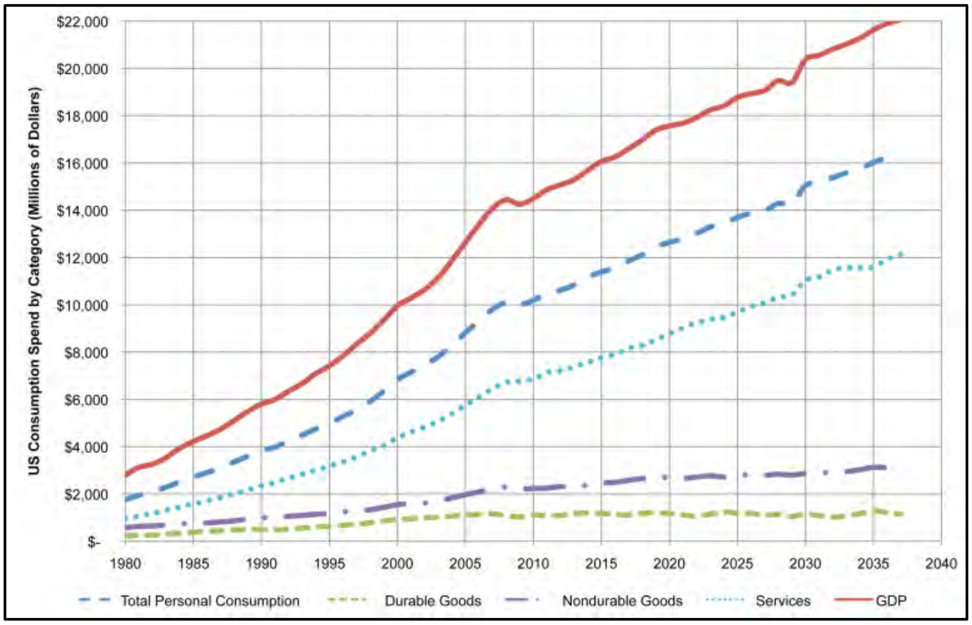


Figure 6-8 GDP of Major Global Economies under the Millions of Markets Scenario

Source: Snapshot of the World 2037: Millions of Markets scenario brochure

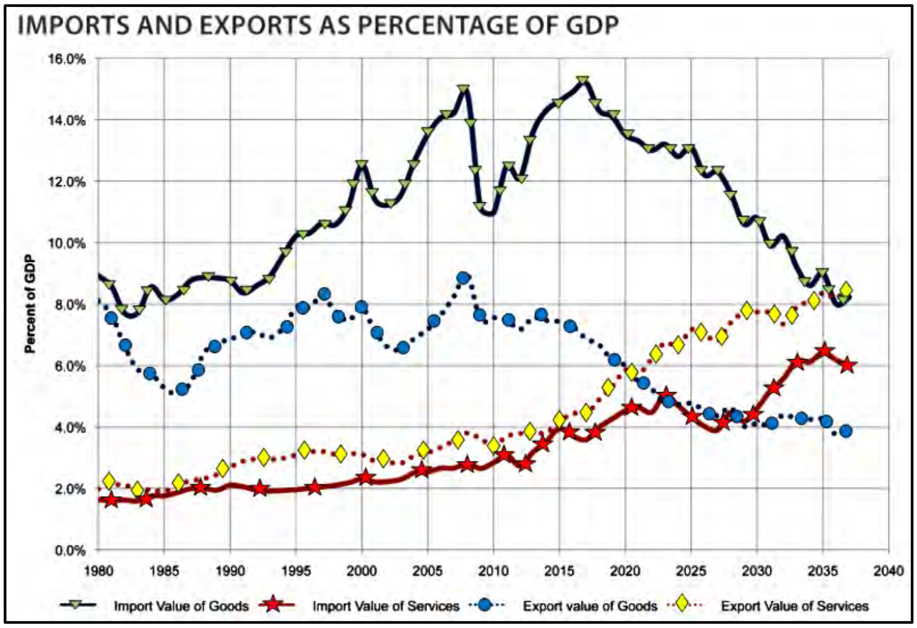


Figure 6-9 Imports and Exports as a Percentage of GDP under the Millions of Markets Scenario

Source: Snapshot of the World 2037: Millions of Markets scenario brochure

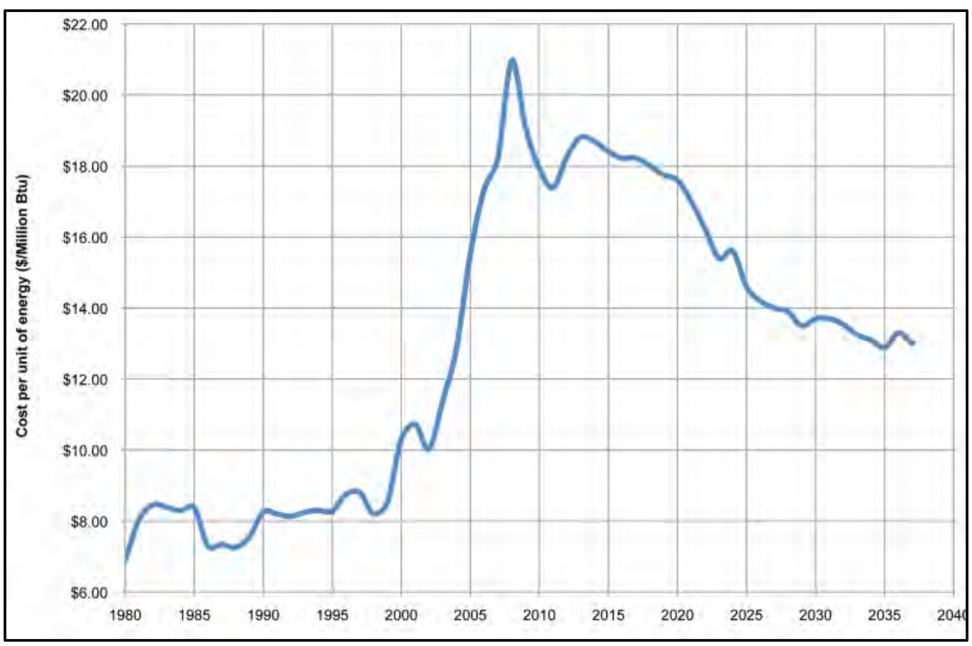


Figure 6-10 Average US Energy Cost Across all Sources under the Millions of Markets Scenario

Source: Snapshot of the World 2037: Millions of Markets scenario brochure

6.3 DEVELOPMENT OF BORDER REGIONS

Early in the process, the project team identified the need to divide the north and south borders into distinct border regions. These regions allow for the association of scenario-based results with locally relevant characteristics. The starting point for defining these regions were the existing Border Master Plans and a desire to maintain consistency with existing political geographies, such as state and provincial boundaries. Many regions focused on key metropolitan areas such as Vancouver, San Diego, Detroit, and El Paso; other regions, lacking a metropolitan focus, centered on the geographical distance between major urbanized areas, such as the Plains Area between northern Washington State and Michigan. Initially, eleven broad border regions were established. **Figure 6-11** shows these regions.

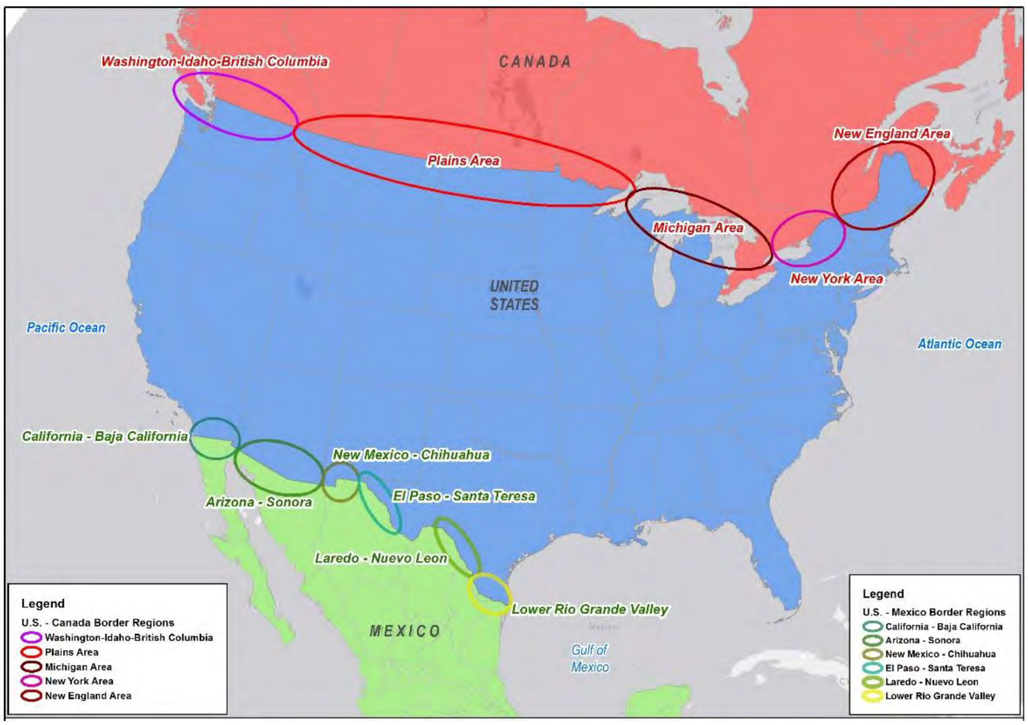


Figure 6-11 General Definition of Border Regions

Source: Mapping for Scenario Planning of Future Freight and Passenger Traffic Flows across the US/Mexico and US/Canada Borders

Further refinement of the general border region definition was conducted using boundaries of counties in the US, Municipios in Mexico, and Census Divisions in Canada. These sub-areas were extended roughly 100 kilometers (approximately 60 miles) on each side of the border and then aggregated as per the general regional delineation shown above in **Figure 6-11**. Notably absent from the initial attempt at border region definition was the Canadian border with Alaska; this was corrected as the border regions were further refined.

The area groupings were then merged to form the boundaries of individual border regions, as shown in **Figure 6-12**. There are six regions along the US-Mexico border. Regions 1 through 3 match the individual US state boundaries in this area: California, Arizona, and New Mexico. The border between Mexico and Texas was divided into three separate regions, each focusing on a significant metropolitan area: El Paso, Laredo, and Brownsville.

The US-Canada border was divided into seven regions. Regions 7 through 9 match US state boundaries: Washington and Idaho for Region 7, Montana for Region 8, and North Dakota and Minnesota for Region 9. The former Plains area was further divided due to concerns that proximity to Ontario might influence the eastern portion of the Plains Area in a manner different than the western portion. East of Region 9, which includes some of the most densely populated areas of Canada, the boundaries become more fluid. It was difficult for the project team to state definitively where one metropolitan area's influence began and another's ended; furthermore, Toronto lies at the edge of a land mass between the Detroit and Niagara border crossings. Ultimately, the project team decided to include Windsor, London, and Toronto into the same region with Detroit and Niagara. Montreal's sphere of influence was placed in Region 11 with the rest of upstate New York; New England and the eastern portions of Quebec, along with New Brunswick, were included in Region 12; and the Canadian border with Alaska was included as Region 13.

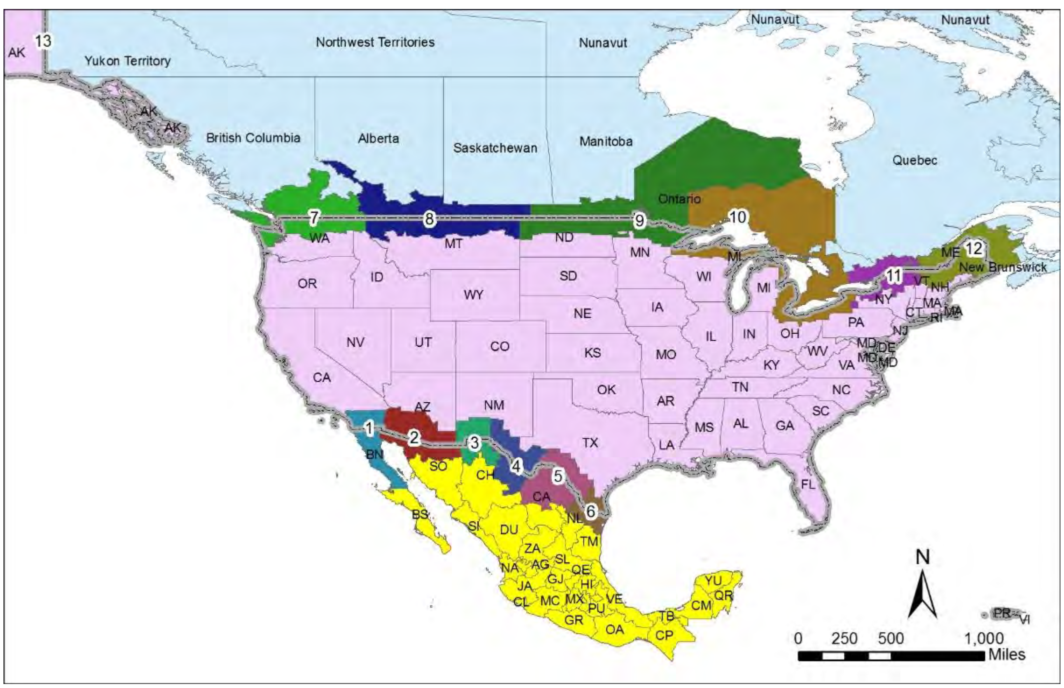


Figure 6-12 Final Definition of Border Regions

Source: Mapping for Scenario Planning of Future Freight and Passenger Traffic Flows across the US/Mexico and US/Canada Borders

6.4 MACRO AND MICRO PERSPECTIVES

In terms of its geographic coverage, the current study was the first of its kind to fully cover the US borders with Canada and Mexico. In the most aggregate sense, the total border crossings can be considered as "macro." However, an initial analysis of data indicated that the north and south whole borders cannot be considered a single analytical unit due to the unique characteristics of each region along the border. Initial attempts at creating one single predictive model for the entire US-Canada border resulted in a model that poorly matched the observed data.

The most accurate model the project team could find required log transforming the key variables; **Figure 6-13** shows a scatterplot (by region) of this initial model and compares observed crossings to modeled crossings. Each point is a year's value of annual passenger crossings. A dotted line has been inserted along the diagonal to mark where the points would fall if the model were a perfect fit. Though the model adequately fits Regions 8 and 11, it significantly underestimates border crossings in all other regions. This indicates that there are unique regional characteristics – even if those characteristics amount to little more than different sensitivities to the same variables – that drive border crossings, and that a single border-wide model is undesirable. Based on this reasoning, a realistic macro perspective for the border crossings is the regional level. The micro perspective of the border crossings was, therefore, considered to be the individual crossings within each region. Given these results, a single border model for the US-Mexico border was not attempted.

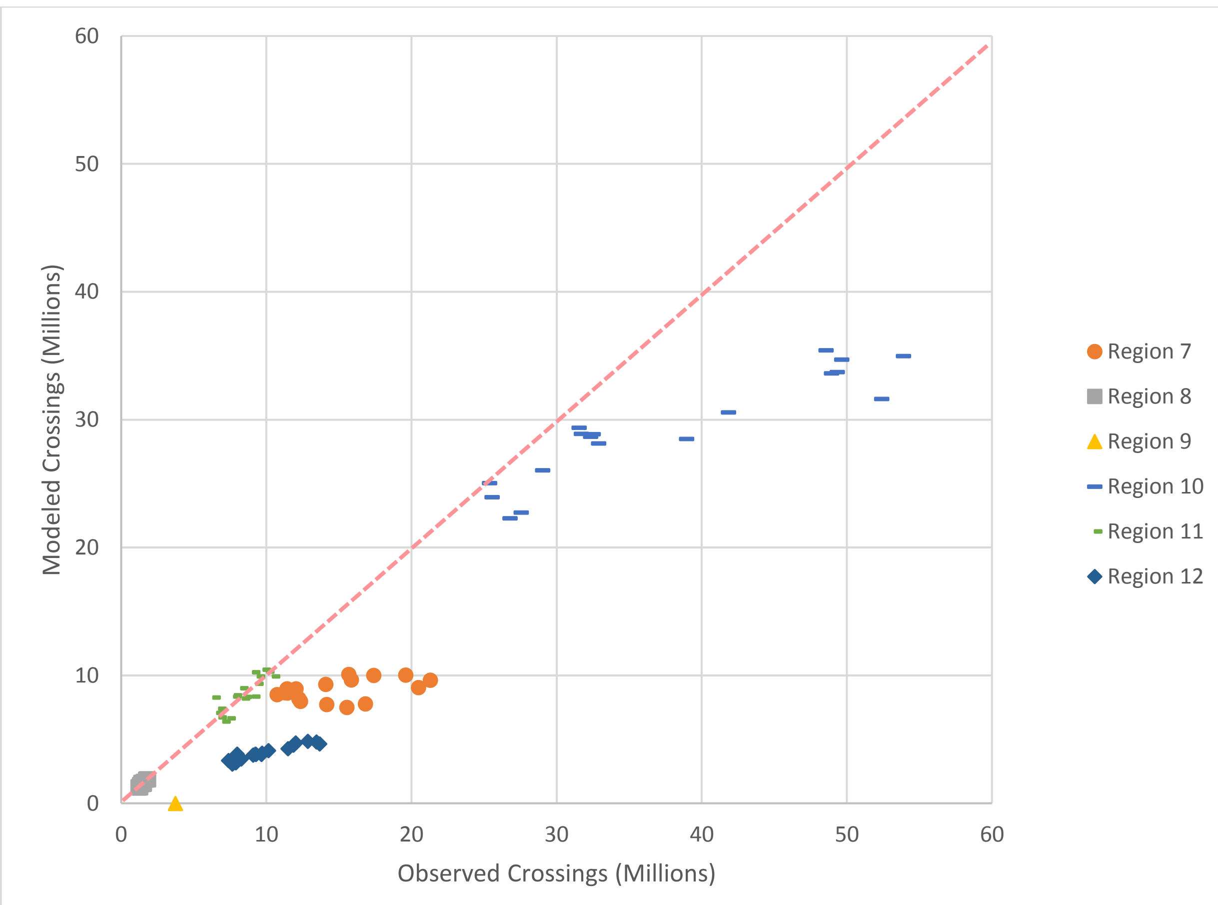


Figure 6-13 Scatterplot of Single Border Model Results US-Canada Border

Source: Models from Scenario Planning of Future Freight and Passenger Traffic Flows across the US/Mexico and US/Canada Borders

The analytical approach for all border regions was generally the same. The following sections provide details of the methodologies used for passenger and freight analyses, which apply to both north and south borders. Another important point is that the difference in the micro and macro approaches primarily applies to passenger analysis. The FAF4 database addresses both macro and micro analyses, depending on how the data are presented.

6.5 MACRO APPROACH FOR US-CANADA & US-MEXICO

Figure 6-14 provides a sequential summary of major steps involved in passenger analysis.

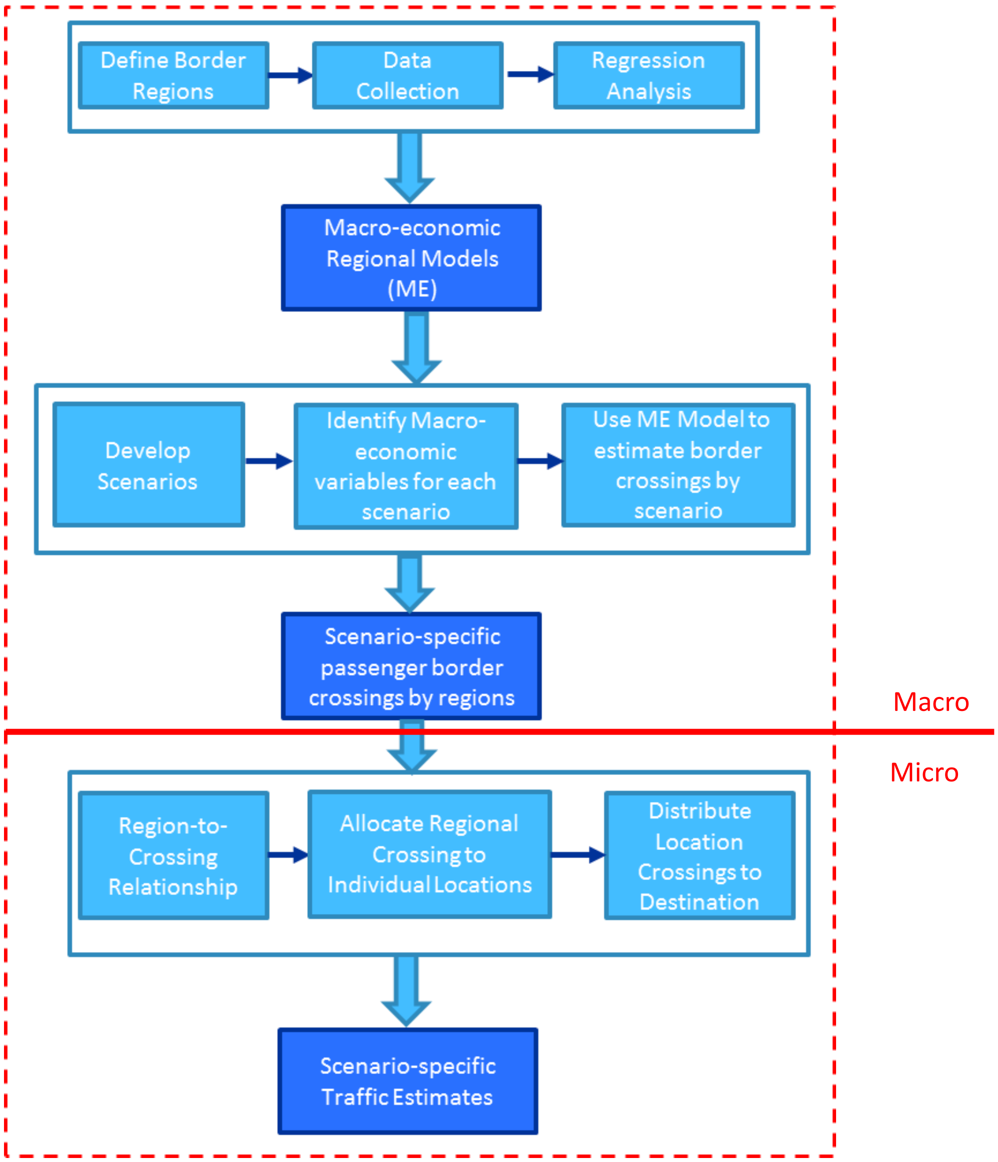


Figure 6-14 Major Steps of Passenger Analysis

The first step was the definition of border regions, so that scenario results would more precisely apply to the unique needs of local, regional, and state-level planning partners. Because border crossing demand is a function of demographic and socioeconomic conditions, the project team collected data that could be differentiated at the regional level of interest. The most common factors considered in traditional travel analyses include population density and employment, which are functions of land-use and socioeconomic conditions. For the purposes of this study, the project team investigated other factors that might provide insights into border crossing demand variations. Details about the data collected are provided in **Section 4** of this report.

The data needed to be internally consistent and equally detailed at comparable levels of geography. For example, in the US, most data was collected at the County level; for Mexico, it was the Municipality level; and for Canada, it was collected at the Census Division level.

The collected data was then reviewed, corrected as needed, and synchronized in terms of time intervals. Data provided by the CEDDS for county-wide population, employment, and GRP were only available in five-year increments from 1995 to 2010 and annually from 2010 to 2015. Population and employment data from StatsCanada and the Mexico Census were also in five-year increments. Missing data was interpolated to fill gaps; thus, interim year data were generated by interpolation.

The data set was then subjected to regression analyses in order to develop macroeconomic models relevant to datasets with cross-border passenger movements. The objective of the top-level regression analyses was to develop a set of macroeconomic models for measuring border movements between the U.S. and Canada and the U.S. and Mexico borders, by the regions defined above.

6.5.1 Regression Analysis

Regression models attempt to describe individual phenomena as a function of variables believed to influence these phenomena. Due to the lack of uniform model sets conducive to estimating border crossings between the regions, the development of a new framework was required. This framework needed to be based on a uniform data set that could apply a standard methodology for forecasting regional border crossings on a scenario-by-scenario basis. As pointed out in **Section 6.4**, early attempts at a single border model proved discouraging, so a separate regression model was developed for each region. This allowed each model to capture unique variable sensitivities in its respective region.

6.5.2 Independent Variables

The project team tested a wide range of variables believed to influence the number of border crossings. Through an iterative process of trial and error, individual variables were plugged into the regression equations and tested for significance. Once a set of variables that seemed likely to yield a reasonable model was discovered, the model was fit to the observed data. Models that yielded a better quality of “fit” were preferred, with fitness measured in terms of R^2 by plotting observed historical border crossings against model estimated border crossings.

In some cases, the sign or magnitude of a coefficient yielded a counterintuitive explanation that could not withstand scrutiny. Variables that led to unreasonable conclusions – such as models where the loss of population correlated with increases in border crossings, or showed carbon-dioxide emissions as a significant predictor of crossings but lacked satisfactory explanations of causality – were excluded, even if the resulting model yielded a better fit.

Generally speaking, the variables that best describe border-crossing movements included population, employment, fuel prices, and currency exchange rates. Not all variables were significant for all regions. In some cases, variables that proved to be insignificant were retained as they yielded reasonable coefficients and were believed to contribute to the explanatory powers of the models.

Some variables expressed evidence of collinearity. In most cases, the most significant collinear variables were retained while the others were discarded; in some cases, variables showing some degree of collinearity were retained. This occurred when the contribution of the collinear variable significantly improved the fit of the model. While collinearity detracts from the ability to clearly distinguish the contribution of individual variables, it does not detract from the predictive power of a model. Because this is a scenario planning forecasting exercise, preference was given to a model's predictive power.

Table 6-1 lists the independent variables used along the US-Canada Border. It also includes the data source and geographic scale of the data used in estimating the regression models. **Table 6-2** provides similar information for US-Mexico border regions.

Table 6-1 Independent Variables for US-Canada Border

Variable	Units	Data Source	Period	Geography
Population: Canada	Persons	StatsCanada	1995-2015	Regional
Population: US	Persons	Woods & Poole	1995-2015	Regional
Rate of Unemployment: Canada	Percent	World Bank	1995-2015	National
Rate of Unemployment: US	Percent	World Bank	1995-2015	National
Employment: Canada	Persons	StatsCanada	1995-2015	Regional
Employment: US	Jobs	Woods & Poole	1995-2015	Regional
Currency Exchange Rate: Canada to the US	Ratio	World Bank	1995-2015	National
Price of Crude Oil: Dollars per Barrel	US Dollars	World Bank	1995-2015	National
Price of Gasoline: Ontario	US Dollars	StatsCanada	1995-2015	Regional
Price of Gasoline: MI, WI, OH, PA, NY	US Dollars	US Energy Information Administration	1995-2010	Regional

Table 6-2 Independent Variables for US-Mexico Border

Variable	Units	Data Source	Period	Geography
Gross Regional Product: US	US Dollars	Woods & Poole	1995-2015	Regional
Rate of Unemployment: Mexico	Percent	World Bank	1995-2015	National
Currency Exchange Rate: Mexico to the US	Ratio	World Bank	1995-2015	National
Price of Crude Oil: Dollars per Barrel	US Dollars	World Bank	1995-2015	National
Price of Gasoline: CA, AZ, TX	US Dollars	US Energy Information Administration	1995-2010	Regional

Table 6-3 lists the independent variables with coefficients for each region. Two of the variables shown below are derived variables; i.e., their values were not determined directly from a data set but were calculated based on a combination of variables in **Table 6-1**. These derived variables include the value of "Population: Regional", which is the sum of "Population: Canada" and "Population: US"; and the ratio of "Canadian to US Unemployment," which is calculated by dividing "Rate of Unemployment: Canada" by "Rate of Unemployment: US." For variables not used in a particular region, coefficients are shown as NA. **Table 6-4** provides similar information for the US-Mexico border regions.

Table 6-3 Model Coefficients by Region; US-Canada Border

Variables	Coefficients by US-Canada Border Regions						
	7	8	9	10	11	12	13
Population: Border Region: International	NA	1.05E+00	NA	NA	NA	1.52E+01	2.46E-01
Population: Border Region: Canada	3.27E+01	NA	2.98E+00	NA	3.54E+00	NA	NA
Ratio of Canadian Unemployment to US Unemployment	NA	6.22E+05	1.10E+06	NA	NA	NA	1.22E+05
Employment: Border Region: Canada	-8.99E+01	NA	NA	NA	-1.20E+01	-1.19E+02	NA
Employment: Border Region: US	NA	NA	NA	NA	3.05E+01	9.02E+01	NA
Employment: Border Region: US: Manufacturing	NA	NA	NA	7.13E+04	NA	NA	NA
Exchange Rate: Canadian to US	3.21E+07	NA	NA	3.69E+07	NA	9.37E+06	NA
Price of Crude Oil: US Dollars per Barrel	NA	NA	-6.05E+03	NA	NA	NA	- 1.33E+03
Price of Gasoline: MT	NA	-1.92E+03	NA	NA	NA	NA	NA

Table 6-4 Model Coefficients by Region; US-Mexico Border

Variables	Coefficients by US-Mexico Border Regions					
	1	2	3	4	5	6
Gross Regional Product: Border Region: US	2.28E+02	1.22E+02	5.29E+02	1.29E+03	2.77E+03	1.37E+03
Unemployment Rate: Mexico	-1.06E+07	-1.95E+06	-1.85E+05	-5.19E+06	-3.88E+06	-5.09E+06
Exchange Rate: Mexican to US	NA	1.62E+08	NA	4.17E+08	2.84E+08	5.11E+08
Price of Crude Oil: US Dollars per Barrel	NA	-7.65E+04	NA	NA	NA	NA
Price of Gasoline: CA	-1.56E+07	NA	NA	NA	NA	NA
Price of Gasoline: TX	NA	NA	NA	-8.43E+06	-6.13E+06	-1.11E+07

After fitting the regression models, a constant was added to calibrate each model so that final estimated values were consistent with observed values. These constants are shown in **Table 6-5** and **6-6** for Canada and Mexico, respectively.

Table 6-5 Model Calibration Constants by Region; US-Canada Border

	Calibration Constants by Border Regions						
	7	8	9	10	11	12	13
Constant	3.62E+07	-1.20E+05	-1.10E+06	-5.77E+07	-2.04E+07	1.53E+05	-7.78E+05

Table 6-6 Model Calibration Constants by Region; US-Mexico Border

	Calibration Constants by Border Regions					
	1	2	3	4	5	6
Constant	1.05E+08	-5.65E+06	-1.65E+06	5.73E+05	-1.08E+07	-6.11E+06

6.5.3 Regression Analyses Summary

As indicated in the above paragraphs, the regression analyses resulted in the development of macroeconomic models for each region. The coefficients indicate the degree to which the variable is related to the border crossings. The sign of coefficients also provides important information: a positive coefficient indicates a positive relationship with border crossings, and vice versa.

Another important measure is the quality of fit of the model against the observed data, which is indicated by the Correlation Coefficient R^2. An R^2 of 1.0 indicates a perfect fit, with lower values indicating a weaker relationship. **Table 6-7** shows the R^2 values for US-Canada regions and **Table 6-8** for US-Mexico regions.

Table 6-7 R^2 Values by Border Regions; US-Canada Border

	R^2 Values by US-Canada Border Regions						
Region	7	8	9	10	11	12	13
R^2	0.94	0.72	0.72	0.93	0.91	0.97	0.69

Table 6-8 R^2 Values by Border Regions; US-Mexico Border

	R^2 Values by US-Mexico Border Regions					
Region	1	2	3	4	5	6
R^2	0.86	0.81	0.66	0.73	0.71	0.92

Figure 6-15 shows a scatterplot of the US-Canada regional models placed on the same graph. This graph compares directly with the plot shown previously in **Figure 6-13,** but also includes Region 13. As demonstrated in the figure, individual regional models yield a much more accurate estimation of total border crossings than the single border model did. The US-Canada border models tend to fit very well, with relatively few outliers.

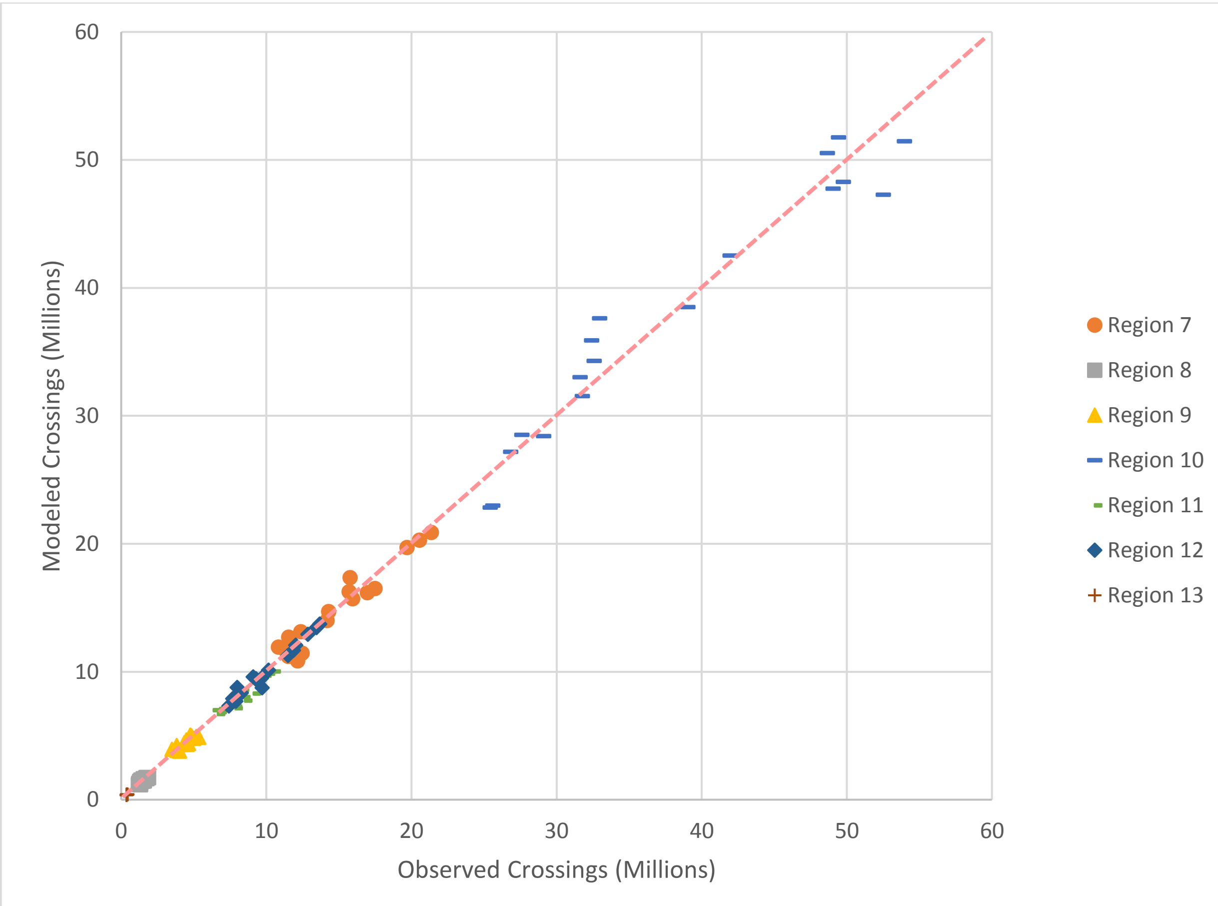


Figure 6-15 Scatterplot of Regionally Specific Model Results US-Canada Border

Source: Models from Scenario Planning of Future Freight and Passenger Traffic Flows across the US/Mexico and US/Canada Borders

Figure 6-16 shows a scatter plot of the results from the US-Mexico models. Though a relatively accurate estimation of border crossings, these models are not as exact as those for the US-Canada border. Models for Regions 1 and 4, in particular, show erratic behavior. The use of nationally scaled unemployment data, as opposed to regionally based employment data on the Mexican side of the border regions, is a likely cause of this, as regional Mexican employment data following the Great Recession was not available. In the future, regional unemployment rates, as opposed to national ones, may improve these models.

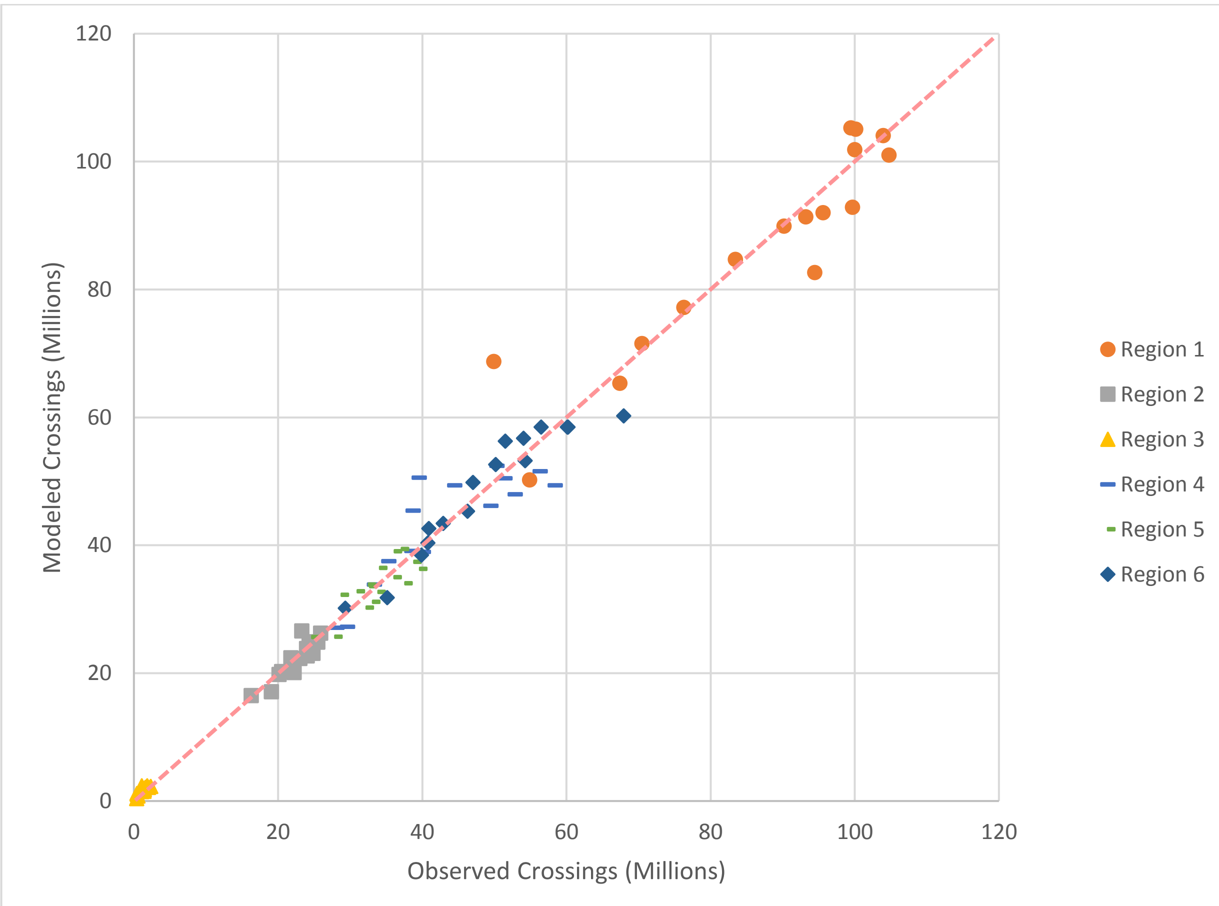


Figure 6-16 Scatterplot of Regionally Specific Model Results US-Mexico Border

Source: Models from Scenario Planning of Future Freight and Passenger Traffic Flows across the US/Mexico and US/Canada Borders

Detailed outputs of regression analysis for each region are provided in **Appendix-H**.

6.6 MICRO APPROACH FOR US-CANADA AND US-MEXICO

6.6.1 Distribution of Regional Crossings

Once scenario-specific regional border crossing forecasts were developed, the next step was to allocate the regional crossings to individual crossing locations and calculate the reverse direction of traffic (i.e., U.S. flow into Mexico or Canada). It was originally planned to utilize a two-tiered probabilistic allocation, using either a nested logit approach if supported by the available data or a simplified proportional allocation based on observed trends.

The nested logit approach would identify clusters of border crossings within each region, and the resulting set of clusters would serve as the first tier of the choice model. Once crossings were allocated to the clusters, the individual crossing locations within that cluster would form the second tier. The model would then allocate the cluster crossings to the individual crossing locations.

A nested logit model is made by combining groups of separate multinomial logit models into a larger framework; for example, a simple multinomial logit used in transportation applications is typically given as:

$$P = \frac{e^U}{\sum_{i=1}^{n} e^{U_i}}$$

Where: P is the probability of selecting a particular choice, U is the utility of choice, and n is the number of choices available.

Without access to revealed or stated preference surveys of individual border crosser behavior, however, it was not possible to develop a choice model in the traditional way. Traditionally, surveys in which respondents are asked a series of questions designed to reveal the underlying factors of their behavioral choices – for example, the crossing of a border – are used. In this case, it was necessary to infer choices from the characteristics of the crossing locations themselves without reference to the individual traveler.

A simpler allocation method was used, based on percentages calculated from historical trends at individual crossing locations. This data were applied to forecast regional crossings. The resulting model is less desirable than the logit model because it is less flexible in assessing impacts of potential future crossings; however, this technique may be more appropriate for the study, as the ultimate goal is to assess each scenario's impact on the existing border crossings for planning purposes.

6.6.2 Bi-directional Traffic Flow

This section summarizes the steps taken and the data sources used in the creation of a method for estimating outgoing traffic flow across the U.S./Mexico and U.S./Canada Borders, given the projections of future incoming traffic flow based on the method described above for macro analysis. The following data sources were assessed for their application to this process:

Canadian Border

- The Canada-United States Transportation Border Working Group Border Crossing Database (BCD) 2006-2010, which contains crossing data by mode from the US to Canada for almost all ports.
- The Public Border Operators Association (PBOA), which provides crossing data by mode for 11 ports in Ontario.

- The Ontario Ministry of Transportation Year 2012 Commercial Vehicle Survey, an hourly bi-directional count data taken for two weeks at Ontario ports in 2012.
- Canada Border Services Agency (CBSA) the US to Canada, which provides monthly crossing data for 18 crossing locations, from 2009-2015.
- TDA Passenger Vehicle Survey, a bi-directional hourly expansion weights and counts for 14 crossings in 2000, 2007, 2009, 2011, 2012, 2013, and 2015.
- ezbordercrossing.com, which hosts descriptions of all Canadian crossing locations in narrative form.

Mexican Border

- Southern California Association of Governments’ (SCAG) Imperial Cross-Border Survey Report, which offers inbound and outbound crossing data during a 2-week period in 2007 for three crossing locations in California.
- Texas DOT: Texas-Mexico International Bridges and Border Crossings, 2013, which contains descriptions of all existing and proposed ports of entry in Texas.

Other Data Sources

- HMPS AADT - shapefiles of major highways in the United States, with average annual daily traffic data (2013 & 2013).
- Google Earth Imagery.

Inbound traffic (Mexico to U.S. and Canada to U.S.) at each crossing point was first calculated using the approach discussed in **Section 6.6.1**. To estimate outbound traffic, a directional factor was applied to projected inbound traffic for each individual crossing. All of the above data sources were analyzed for usefulness in creating the directional factor.

For the Canadian border, the Transportation Border Working Group’s Border Crossing Database (BCD) was chosen as the primary data source for two reasons: firstly, it contains historical crossing data for all but seven non-ferry border crossings, making it the single most complete dataset available for outbound traffic available; secondly, BCD is assumed to be the most direct comparison to BTS available, because BTS inbound traffic data is included alongside outbound data in BCD prior to the year 2010. Closer examination of the two datasets revealed that at the national level, the ratio of incoming to outgoing traffic counts very closely approximated 1:1, which further suggests that the BCD and BTS datasets are comparable.

Where BCD outgoing counts were available, the ratio of incoming to outgoing traffic at each individual crossing in 2010 was used to create the directional factor. It was assumed that all other things equal, this ratio remains constant. In some cases, the ratio was adjusted to account for location-specific circumstances (for example, a crossing that allows buses in one direction but not in the other, or a crossing with three lanes in one direction but only one in the other). Data from 2006-2009 were also reviewed to help identify cases in which 2010 information might constitute an outlier.

Where BCD outgoing counts were not available, other data sources were used. For one crossing in Ontario, the CBSA US to Canada dataset was compared with BTS to create the directional factor. Although PBOA counts were utilized to disaggregate BTS data from the port city level to the individual crossing level, this dataset was not used to determine directional factor because it appeared to be less directly comparable to the BTS dataset. A combination of data sources was used to estimate directional factors for the remaining crossings outside of Ontario.

Average annual daily traffic (AADT) data from 2012 was available for one such crossing: Calais-International Avenue Bridge. Incoming traffic in 2012, recorded in the BTS database, was subtracted from the total annual (bi-directional) traffic in order to estimate crossings into Canada; however, this method resulted in an estimated ratio of incoming to outgoing traffic of nearly 7:1. The most likely source of this discrepancy is that the BTS database for this area actually reports crossings at three separate points of entry (POEs) as a single location. Since the AADT and BTS data were non-comparable, the project team assumed a 1:1 ratio instead.

For the remaining crossings outside of Ontario, a combination of written descriptions from ezbordercrossing.com and visual inspections were used to inform the estimations of directional factors. Unless there was information that indicated otherwise, outgoing traffic was assumed to roughly mirror incoming traffic and a 1:1 ratio was used.

On the Mexican border, outgoing traffic was assumed to roughly mirror incoming traffic at all crossings on the Mexican border, including those in California. All crossings were inspected visually using Google Earth; crossings in Texas were reviewed using the Texas-Mexico International Bridges and Border Crossings inventory publication; and others were reviewed using state DOT websites. The Texas-Mexico inventory indicated that one crossing allowed incoming traffic only. At this location, outgoing demand was assumed to mirror incoming demand, so the corresponding outgoing trips were allocated to the other three crossings in the port city. Because no information indicated otherwise, outgoing traffic was assumed to roughly mirror incoming traffic and a 1:1 ratio was used for all other crossings in Mexico.

6.7 FREIGHT ANALYSIS

The freight analysis approach is different from passenger analysis in several respects. Firstly, the FAF model already exists and was modified for this study. Consequently, there was no regression analysis involved in freight analysis. FAF data was disaggregated to include border regions and destinations outside the US.

Figure 6-17 shows the major steps involved in the freight analyses, which includes FAF Data as the starting point and relies upon other resources to incorporate the scenario assumptions into the broader framework of FAF model. The full details of the FAF modeling process can be found in the official FAF documentation[5]. Details of methodology for freight analysis are provided in the following paragraphs.

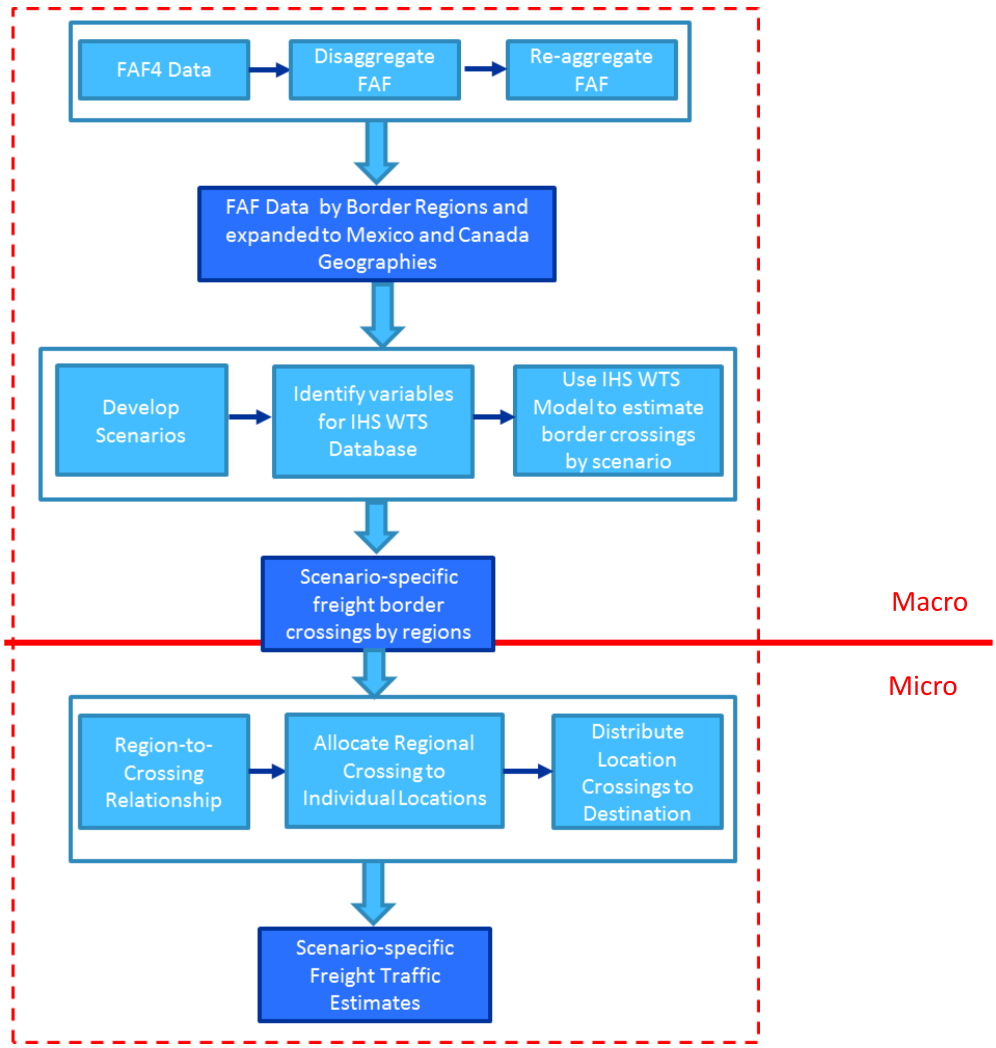


Figure 6-17 Major Steps of Freight Analysis

6.7.1 FAF4

The foundation of the freight movement forecast is the Freight Analysis Framework version 4 (FAF4). This database captures the movement of all import and export traffic moving through seaports, as well

[5] http://www.ops.fhwa.dot.gov/freight/freight_analysis/faf/

as all cross-border activity with Mexico and Canada and all U.S. domestic traffic. The FAF provides baseline forecasts of these freight movements through the year 2045.

For this project, the FAF was disaggregated to more specific geographic levels in order to identify the movements that impact border regions most notably. The forecasts were also adjusted to reflect the four scenarios: Naftástique, One World Order, Millions of Markets and Global Marketplace. This section provides a description of the additional data used and processing performed to produce a model consistent with FAF4 and the study requirements.

6.7.2 Geographic Disaggregation

FAF4 geographic regions consist of the following:

- Outside the US: Country level only (all of Mexico, all of Canada).
- Inside the US: FAF Zones (Metro areas, the rest of states).
- Crossing points: FAF Zones.

The goal of disaggregation was to focus on the State and Provincial levels for Mexico and Canada, respectively. Then, the flows were further divided into sub-provincial, county, and municipal levels and re-aggregated into border regions.

The main source of the first-level disaggregation of the United States/Mexico and United States/Canada cross-border was data derived from the BTS trans-border movement database. The project team used this data to disaggregate the Freight Analysis Framework cross-border flows on the Mexican and Canadian sides of the movement. This source provided information on cross-border shipments by truck, rail, and pipeline in terms of declared value (in U.S. dollars) at customs inspection points on the border. For example, information on southbound shipments to Mexico were provided in terms of U.S. state of origin, crossing point, and Mexican state of destination and (separately) as the U.S. origin, commodity, and Mexican destination. For northbound Mexico/US shipments, the U.S. state of destination and crossing point are shown, but origins are displayed simply as “Mexico”; however, physical volume (tons) is reported for these shipments, along with value.

Commodities are classified based on the international Harmonized Commodity Coding and Classification System. The project team worked with FHWA and BTS to use a consistent translation between this commodity classification and the 2-digit Standard Classification of Transported Goods (SCTG) coding used in the FAF. Further information regarding the data fields available can be found in **Table 6-9**.

Table 6-9 Data Available by Source

Source	Data Provided
U.S. Customs	Crossing point, 6-digit Harmonized Commodity Code, total value, seaborne weight, seaborne value, overland value; Crossing point customs district, 10-digit Harmonized Commodity Code, total value, seaborne weight, seaborne value, overland value; Crossing point and origin state for exports; 6-digit Harmonized Commodity Code and origin/destination state.

OST-R BTS: U.S. Imports and Exports with State and Port detail	Crossing point, mode, Mexican State/Canadian Province of Destination (only leaving the United States), weight of shipments (only entering United States), value of shipments, U.S. State of Origin or Destination.
OST-R BTS: U.S. Imports and Exports with State and Commodity detail	2-digit Harmonized Commodity Code, mode, Mexican State/Canadian Province of Destination (only leaving the United States), weight of shipments (only entering United States), value of shipments, U.S. State of Origin or Destination.

These sources were used to triangulate a best-fit model that conforms to the constraints provided as closely as possible. The project team developed an iterative methodology that assigns flows based on these totals until the model converges to a potential solution. **Figure 6-18** shows an example using Canadian data, where one file containing data on the state of origin, province of destination, and commodity is combined with a file that contains data on the state of origin, province of destination, and border crossing, as well as a file that contains border crossing and commodity, to produce a full record. The resulting record contains full information about the state of origin, province of destination, commodity, and border crossing by weight and value.

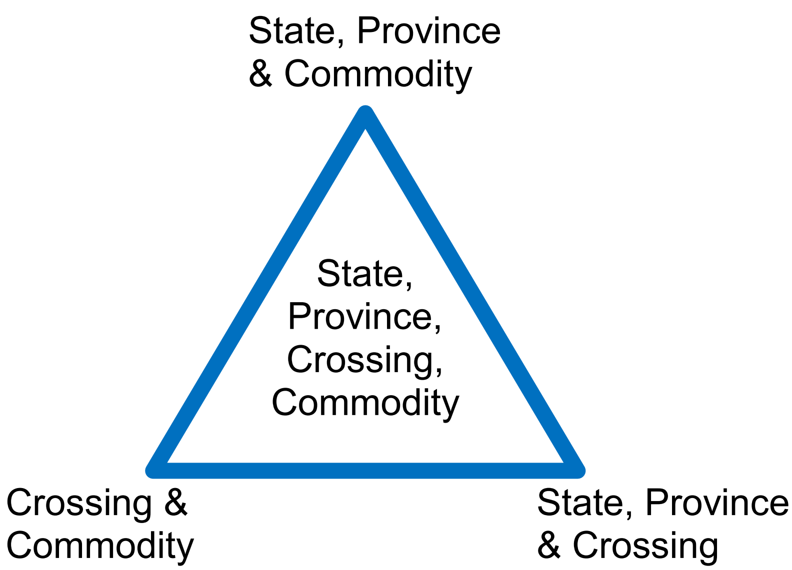


Figure 6-18 Triangulation Process to Produce Complete Flows

The results of this disaggregation are movements that reflect likely foreign origin and termination geography consistent with the place of border crossing; that is, each crossing has a distinct profile based on its location along the border. For example, Canadian origins and terminations look very different at the New York State border than they do at the Washington border: in our analysis, roughly 98% of all northbound traffic through Washington State terminates in British Columbia, while movements through New York State terminate largely in Ontario (77%) and Quebec (22%).

The weights of movements leaving the United States is available in the FAF4 dataset, along with the value of the commodities shipped. Value-per-ton ratios were created, based on average dollars per ton from the FAF4 database.

In a small number of cases, the source data contained crossings that indicated the point at which the movement cleared customs, rather than the physical point of the border crossing. In those cases, we retained the crossing from the source data for the sake of consistency with the FAF and customs datasets. This is a particularly noticeable problem with pipeline movements of crude oil originating in Canada.

For movements into the United States from Mexico, additional data processing included allocating the traffic by Mexican state. This was primarily done using data from the latest Mexico Economic Census to determine the manufacturing locations of goods in Mexico being imported into the United States. The latest census is data from base year 2012, which is consistent with FAF4 and contains information on a number of employee and economic outputs by NAICS code and Mexican State and Municipio. The project team used the detailed geography and commodity information in the census to determine likely places of origin for the northbound movements, and then extended this information to probable crossing points and final destinations. Because the census provides data at the Municipio level, combining this data into Mexican states or into the defined border regions was possible. So, for southbound movements where the state is available from BTS, the census data was run through an input/output matrix to determine the likely destinations by Municipio, which were then attached to the defined border regions.

Additional processing was required to further disaggregate the Canadian data into Census Districts. Statistics Canada has data available from the Business Register, which provides a number of establishments both by NAICS and range of employees. Originating tonnage was proportionally extended by this measure to provinces and allocated to the defined border regions. As was done with the Mexican data, the Business Register data were run through an input/output matrix to determine likely destinations. These were then included in the border regions.

The border region analyses also required that the US-side border data be disaggregated from FAF Zones. The project team relied heavily on its proprietary database Transearch, which contains county-level flows by four-digit Standard Transportation Commodity Code (STCC), as well as County Business Patterns, to determine the proportional split of movements within the defined border regions for those FAF Zones where disaggregation was necessary.

6.7.3 Freight Forecasts

The baseline freight forecast was taken from the latest appropriate FAF forecast. For the baseline forecast, geographic variation over time was not considered, but commodity forecasts were. In other words, the growth rates by Mexican State and Canadian Province were determined by the commodity mix considered in the baseline forecast. The baseline tonnage forecast for Canada and Mexico as determined in FAF4 are shown in **Figures 6-19** and **6-20**, respectively.

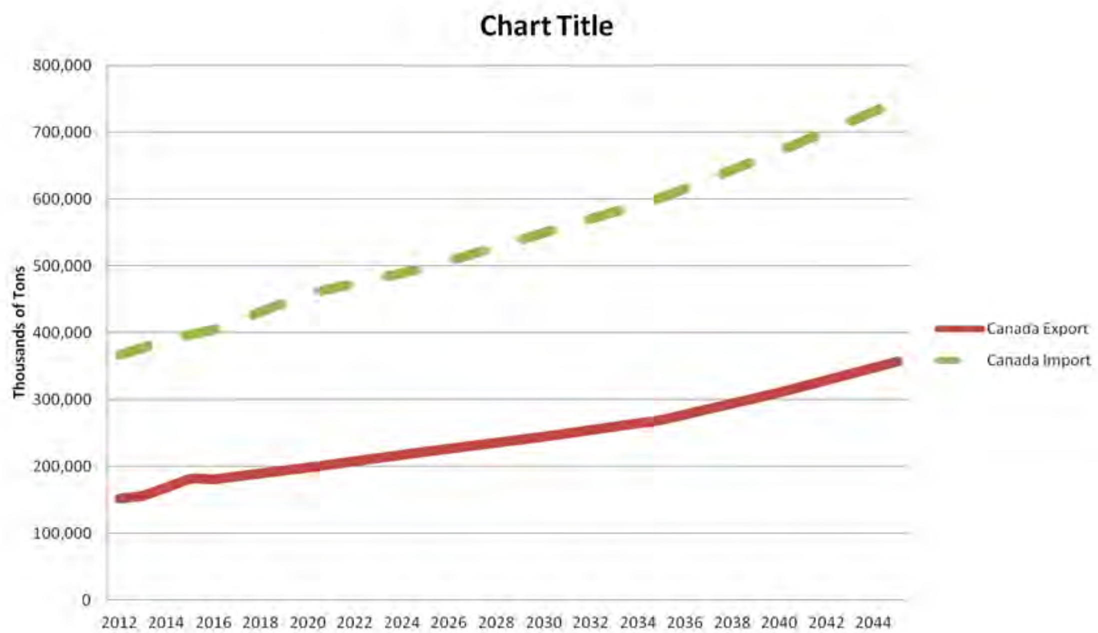


Figure 6-19 Total FAF Tons, Canadian Imports and Exports

Source: FHWA's Freight Analysis Framework 4

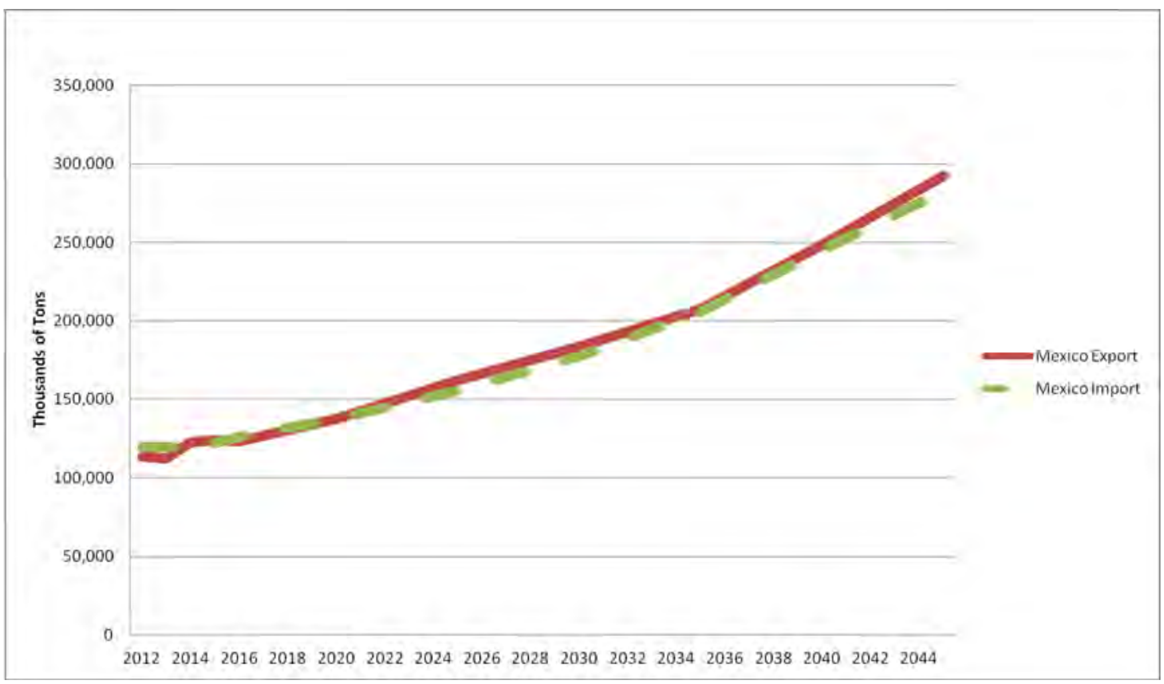


Figure 6-20 Total FAF Tons, Mexican Imports and Exports

Source: FHWA's Freight Analysis Framework 4

The trade scenarios not only have implications for NAFTA trade, but also for how NAFTA countries trade with the rest of the world. FAF4 contains information about overseas trade for the United States but does not have any information or forecasts about global trade in Mexico or Canada. For baseline data on Canadian and Mexican trade with non-US trading partners, forecasts were provided via the World Trade Service (WTS).

The WTS database contains historical and forecasted bilateral trade data broken down by country (or region), commodity, trade concept, and direction of trade (i.e., exports or imports). The WTS database covers all global trade broken down into 106 countries and regions. The project team's world trade forecasting models rely on comprehensive macroeconomic history and forecast databases. Among the data used are population, GDP, GDP deflators, industrial output, foreign exchange rates, and export prices by country.

For the freight scenario forecast, changes to the drivers were fed through the forecast model to develop a customized forecast for each scenario. Forecasts for some economic indicators – such as country-level GDP as well as trade growth factors – had already been specified in the definition of those scenarios. These forecasts were used in place of the baseline forecast factors where available.

6.8 DEVELOPMENT OF ANALYTICAL FRAMEWORK FOR PASSENGER

After developing the macro and micro models, the project team implemented these models within an analytical framework that possesses the following primary capabilities:

- To take the variables as inputs and calculate the border crossings at regional and location level.
- To modify the growth rates of variables based on the scenario assumptions.
- To demonstrate sensitivity to change of growth rate assumptions.
- To allow the user to develop additional hypothetical scenarios and/or answer hypothetical questions.

A two-tiered approach to the development of the framework was adopted. During the first tier, the analytical model was implemented in Microsoft Excel, which offered visual clarity of the data flow and ease of testing during the development phase. However, it required the user to be very familiar with the structure of the spreadsheet.

The second tier of the framework entailed developments to enhance the user experience of the already developed analytical model. This second tier is the data visualizer discussed in **Section 6.10**.

Figure 6-21 provides a summary of the analytical framework data flow.

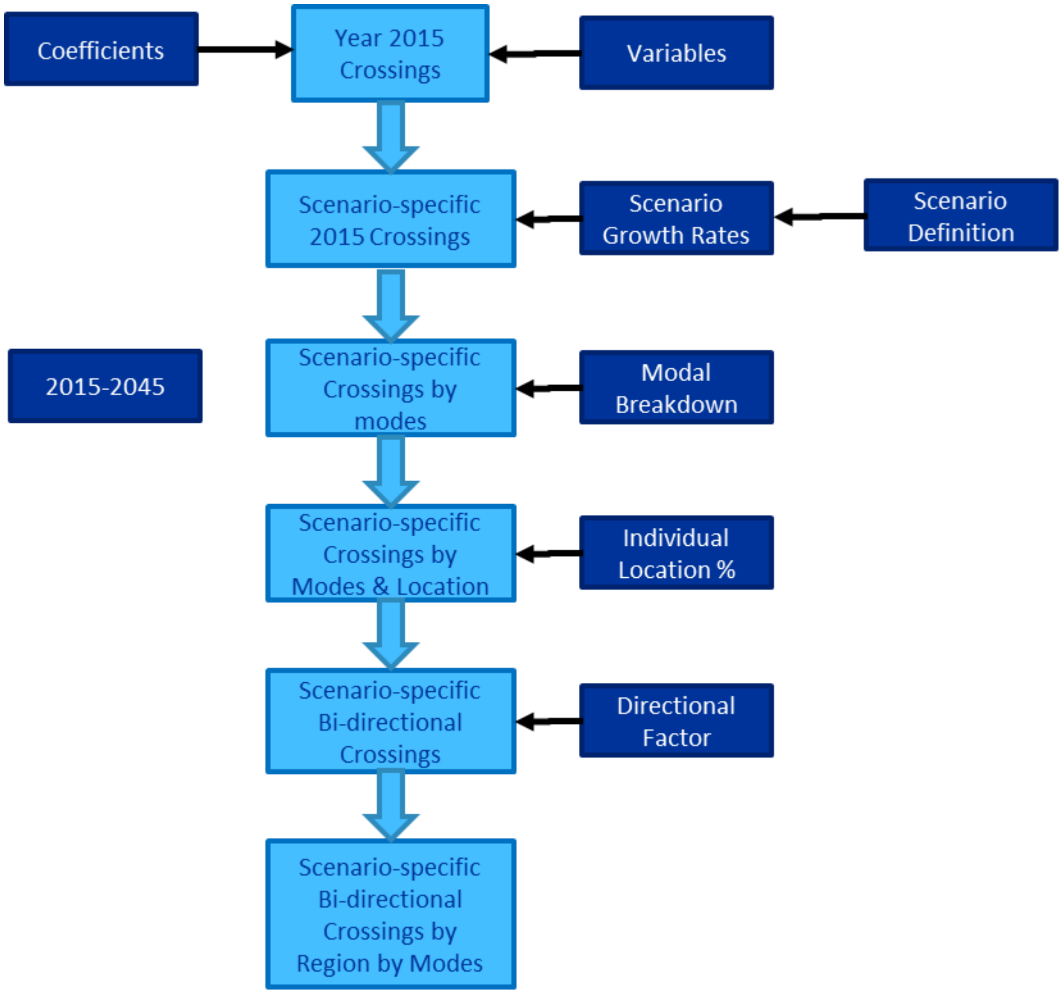


Figure 6-21 Analytical Framework Data Flow Passenger

6.9 DEVELOPMENT OF ANALYTICAL FRAMEWORK FOR FREIGHT

The freight analysis was a product of the FAF model and as such, it consisted of scenario-specific Microsoft Access databases. The development of a separate framework was therefore not involved. However, database queries were developed to cross-tabulate results for export to pre-designed maps as per USDOT specifications. Due to the fact that the FAF computational model is proprietary and not portable, the user can summarize the scenario results in different ways, but cannot analyze additional scenarios. The freight databases contained results broken into FAF modes, so there was no need to have a separate framework for other modes.

6.10 DEVELOPMENT OF ANALYTICAL FRAMEWORK FOR OTHER MODES

The BTS Border Crossing/Entry data reports border crossings by travel mode. Such modes include pedestrian, personal vehicle, bus, truck, and rail. This information was used to determine modal splits at individual POEs. As the volume of border crossing traffic changes from region to region by scenario, impacts to individual POE traffic will change accordingly. This will affect the overall distribution of passenger trips by mode across the US-Canada and US-Mexico borders.

The FAF4 database used for the freight analysis includes an allocation of freight by mode of transport. These modal considerations – which include air, rail, truck, water, pipeline, mail, and other modes –are tied into the specific regional origins and destinations of freight movement. On a scenario by scenario basis, the regional allocations of freight trips change based on the scenarios growth assumptions. These changes to regional allocations affect which modal options are available for individual freight movement which in turn influences the modal distributions of the freight results.

6.11 VISUALIZATION TOOL DEVELOPMENT

One of the major products of this study was a "Visualization System" (VS). The development of the system was based on the conceptual outline summarized below.

6.11.1 Purpose and Need for Visualization System

The purpose for the VS was to:

- Provide a tool/framework that integrates various data pieces.
- Facilitate the review of Scenario Analysis results.
- Provide data/maps for the FHWA Office of Planning, Environment, & Realty (HEP) GIS system.
- Perform further scenario analysis for passenger trips.

6.11.2 Important Assumptions

Important assumptions related to the VS are:

- Visualization tool will provide data/maps/shape files, etc., to become part of the FHWA Office of Planning, Environment, & Realty (HEP) GIS system and/or as required by USDOT.
- No server-side processes will run through the tool.
- Freight components will be limited to the Scenario results.
- The tool is not a replacement for FAF.

6.11.3 Broad Architecture

The broad architecture of the VS comprises the following:

- User interacts with the Visualization Tool.
- The Visualization Tool communicates with the underlying scenario data.
- The tool sends information back as per user request.

- Selected information to become part of the FHWA Office of Planning, Environment, & Realty (HEP) GIS system system.

6.11.4 Functional Elements of the Tool

Primary functional elements of the VS include:

- Provide the ability to select "standard" scenarios.
- Shift from macro level to micro level information.
- Modify the input assumptions of passenger scenarios and see the impact on results.
- Generate Excel Reports as output.
- Export data tables for GIS files as input to the FHWA Office of Planning, Environment, & Realty (HEP) GIS system.

The next section of this document deals with the scenario analyses including the assumptions and results.

7. SCENARIO ANALYSIS

7.1 SCENARIO ASSUMPTIONS

This section focuses on the results of the scenario analysis. These scenarios were based on assumptions derived from the information provided in the *NCHRP 750* scenario planning brochures. Because the quantitative methodology for this study was developed years after the scenarios themselves, not every piece of information provided in those brochures is used in this analysis. The quantitative methodology did take into consideration the information from these brochures, such that the project team made reasonable assumptions regarding adjustments to the variables' values. For example, while the scenario brochures did not provide a quantitative forecast of manufacturing employment, the project team used each scenario's qualitative descriptions about impacts to manufacturing, as well as quantitative forecasts provided in terms of GDP, to make assumptions on whether the growth of manufacturing in Region 10 would be positive or negative and whether growth would be slow or rapid. Similar considerations were made as the project team determined which changes to apply to each of the variables for each of the regions.

7.2 GROWTH ASSUMPTIONS PASSENGER ANALYSIS FOR ALL MODES

The project team adjusted the value of each variable informing the regions' border crossing models to reflect changing conditions over time. These adjustments were made in annual increments out to the study's planning horizon of 2045. Periodic non-linear adjustments to these incremental changes, typically referred to as "shocks," reflect sudden or unexpected changes to growth patterns to better match historical observations.

Each scenario starts with 2015 socioeconomic conditions, but gradually deviate from one another over time. Some scenarios show significant growth in population, while other show slower growth. Some scenarios portray increasing employment; others show decreasing employment. In some scenarios, growth asymmetrically impacts some regions more than others, while other scenarios affect all regions similarly. These scenario growth assumptions for passenger analyses are summarized in **Table 7-1**.

In addition to the four analysis scenarios documented in **Section 6** of this report, a scenario titled "Prevailing Trends" is included. This scenario is added for reference purposes and is based on the continuation of the current trends of factors affecting cross-border traffic. The project team used the Prevailing Trends to better inform the assumption process, allowing the project team to determine whether the information provided in the scenario brochures indicated that a particular variable's growth should be higher or lower than the prevailing trend. This helped to establish a benchmark on the reasonableness of each assumption.

Table 7-1 Scenario Assumptions For Passenger Analysis

	Prevailing Trends	Naftastique	One World Order	Global Marketplace	Millions of Markets
Population	Significant and steady population growth along Canada's southern border as well as on both sides of the US - Mexico border. Population in the upper Midwestern and Northeastern US shows fairly low growth.	Steady population growth consistent with prevailing trends	Population growth significantly slows down in the border regions	Steady population growth consistent with prevailing trends	Steady population growth consistent with prevailing trends, except in British Columbia where population growth is slightly lower then the prevailing trend
Employment	Steady employment increases in most sectors of the economy in all countries except for manufacturing in the northern US, unemployment decreases a few tenths of a percent in the coming decades, but remains fairly stable at current levels	Overall increase in jobs in the US relative to prevailing trends including a return of manufacturing to northern states, sharp decline in unemployment in all three countries	Employment growth significantly slows down while unemployment increases.	Steady increase to employment consistent with prevailing trends plus a return of manufacturing to Northern states that begins to exceed historic growth rates, unemployment rates are consistent with prevailing trends	Steady increase to employment consistent with prevailing trends for most regions plus a slight return of manufacturing to northern states, Canadian employment growth in Ontario and Quebec exceed prevailing trends, unemployment rates are consistent with prevailing trends

	Prevailing Trends	Naftastique	One World Order	Global Marketplace	Millions of Markets
Economic Activity	Steady positive economic growth in all three countries with especially strong economic growth in the Southern and Southwestern US	Significant increases to Gross Regional Product along the US-Mexico border relative to prevailing current trends	Economic growth along the US-Mexico border slows down considerably. Fuel prices increase faster than historic trends.	Continued growth in economic activity consistent with prevailing trends except in Regions 1, 4, and 10 where growth exceeds expected trends	Growth in economic activity along the US-Mexico Border slows down significantly with growth below the prevailing trends but still in the positive direction
Exchange Rates	Continued strengthening of the Canadian dollar against the US dollar until achieving near parity in the later years of the analysis. The Mexican peso strengthens against the US dollar in the short term before weakening slightly and stabilizing at slightly above current rates until weakening again to reach current rates in the latest years.	Continued strengthening of the Canadian dollar and Mexican peso consistent with prevailing trends	Continued strengthening of the Canadian dollar and Mexican peso consistent with prevailing trends	Continued strengthening of the Canadian dollar and Mexican peso consistent with prevailing trends	Canadian dollar strengthens against the US dollar but never quite achieves parity, the Mexican peso is consistent with the prevailing trends

7.3 GROWTH ASSUMPTIONS FREIGHT ANALYSIS FOR ALL MODES

For the freight analyses, the inputs to FAF4 were modified to reflect the following assumptions for each scenario. Major assumptions related to the freight analysis are summarized below:

General Assumptions:

- The latest FAF4 freight forecast was used as the starting point.
- For the purposes of scenario analysis, additional economic variables forming the basis of the FAF4 forecast were considered.
- The baseline forecast of US GDP was used to drive the long-term FAF4 forecast.
- Additionally, the scenario analyses required a forecast of the current US account balance. The baseline balance of trade forecast was used to calibrate the forecast scenarios.

Additionally, each scenario assumed changes that would impact cross-border freight movements. Key assumptions for the Naftastique scenario included:

- Overall trade between Canada, Mexico, and the United States as described in the scenario brochure.
- The growth of baseline trade was adjusted to match the scenario starting in 2015, with the total value of trade by direction and trading partner in FAF4 adjusted to match the growth rates of the trade forecast provided in the scenarios for all forecast years.
- US population grows faster than recent trends and has moved towards the West and South.
- Demand for goods & employment increased by a larger amount over baseline in Southwestern states than it did in the Northeast.

Key assumptions for the One World Order scenario included:

- Energy trade is likely to decline as regulations limit the use of carbon-based fuels.
- Food trade will increase as trade is regulated to push production into environmentally friendly regions.

Key assumptions for the Global Marketplace scenario included:

- Increased growth in raw material and retail trade.
- Economic impacts of global trade on North American trade.

Key assumptions for the Millions of Markets scenario included:

- Declining trade of energy products and growth of raw materials.
- Population growth in smaller cities.

For the One World Order, Global Marketplace, and Millions of Markets scenarios, the project team used these assumptions to inform changes to GDP. These GDP assumptions were combined with the current account balance to establish the total balance of trade between the three countries. The current account balance was used to derive a trade deficit by scenario as a fraction of GDP; this was then used to project future year GDP for the three scenarios, from which freight flows were then estimated.

The Naftastique scenario is unique due to the availability of NAFTA-specific trade data in the *NCHRP 750* scenario definitions. Because trade between NAFTA partners was defined, there was no need to further model the total trade flows for that scenario as future year freight flows could be derived directly from the data provided.

GDP assumptions in trillions of US Dollars derived for the three scenarios requiring them are shown in **Table 7-2** and the modeled trade deficits as a percentage of GDP are presented in **Table 7-3**. These are compared to the FAF4 baseline assumptions for growth.

Table 7-2 Scenario GDP Assumptions for Freight Analysis[6]

Scenario	2015	2016	2020	2025	2030	2035	2040	2045	CAGR
FAF4	16.3	16.6	17.4	18.7	20.4	22.1	23.7	25.2	1.50%
One World Order	13.6	13.7	14	14.5	15	15.9	16.7	17.6	0.90%
Global Marketplace	14.8	15.1	16.3	18.5	20.8	23.4	26	28.9	2.30%
Millions of Markets	16	16.3	17.4	18.8	20.5	21.8	23	24.3	1.40%

Table 7-3 Scenario Trade Deficits as a Percentage of GDP

Scenario	2015	2016	2020	2025	2030	2035	2040	2045
FAF4	-2.6%	-2.2%	-3.0%	-3.9%	-3.8%	-3.7%	-3.3%	-3.2%
One World Order	-2.5%	-2.4%	-2.2%	-1.9%	-1.5%	-1.2%	-0.9%	-0.5%
Global Marketplace	-2.7%	-2.7%	-2.5%	-2.3%	-2.2%	-2.0%	-1.8%	-1.7%
Millions of Markets	-2.6%	-2.9%	-2.8%	-3.1%	-2.5%	-1.8%	-1.3%	-0.9%

7.4 SUMMARY OF RESULTS BY REGIONS AND BORDER CROSSINGS

After the project team established the growth assumptions for each scenario, they were applied to the models and databases used to analyze the border crossings for each region. For passenger crossings, growth assumptions were entered into scenario specific spreadsheet models, which produced an estimated number of daily person crossings for each of the thirteen border regions. For the freight crossing analysis, the growth assumptions of each scenario were applied to the disaggregated FAF4 database to obtain a distinct, full dataset for each scenario and border crossing region.

It is important to note that scenario estimates are not intended to be treated in the same fashion as traditional forecasts. Instead, they are meant to convey a range of possible future results. Each

[6] In Table 7-2, CAGR stands for Compound Annual Growth Rate.

scenario was analyzed independently of each other. Furthermore, each scenario represents a mutually exclusive future, such that if the events of one scenario, such as Naftastique, should come to pass, then the events of another scenario, such as One World Order, would not occur. This study also does not attempt to establish the likelihood of any one scenario occurring.

When reviewing the results, one should consider that:

- Results are provided with respect to border crossings occurring within each of the border regions.
- Freight data are generally expressed in terms of total annual tons crossing the border, although the visualization tool allows the user to delve into greater detail, including viewing crossings by value instead of weight.
- Passenger data are generally expressed in terms of total daily passengers crossing the border.

It should also be noted that the vertical axis on each of the freight graphs has been set to a uniform maximum of 500 million annual tons across all scenarios and all borders; likewise, the passenger crossing graphs have a uniform maximum of 0.8 million of daily passengers. This allows for an easier comparison of all regions across either border. Additional data details for both freight and passenger crossings are contained within the visualization tool that the project team developed for this study.

7.4.1 US-Mexico Results

Figure 7-1 shows the amounts of passengers and freight along the US-Mexico border by regions in 2015. Region 5 has the highest share of freight traffic and Region 1 has the largest share of passenger crossings along the US-Mexico border. While populations in the other Regions are either asymmetrically related population across the border (for example, Region 5 has a large population in Mexico but a relatively small population in the US) or are symmetrical but small (such as Region 3, which has small populations on both side of the border), Region 1 has one of the largest border populations in both the US and Mexico. This concentration of people creates more opportunities to interact across borders and more potential demand for border crossings. Passenger crossings are fairly evenly distributed between Regions 2, 4, 5, and 6. Only Region 3 stands out as the least trafficked border region along the US-Mexico border.

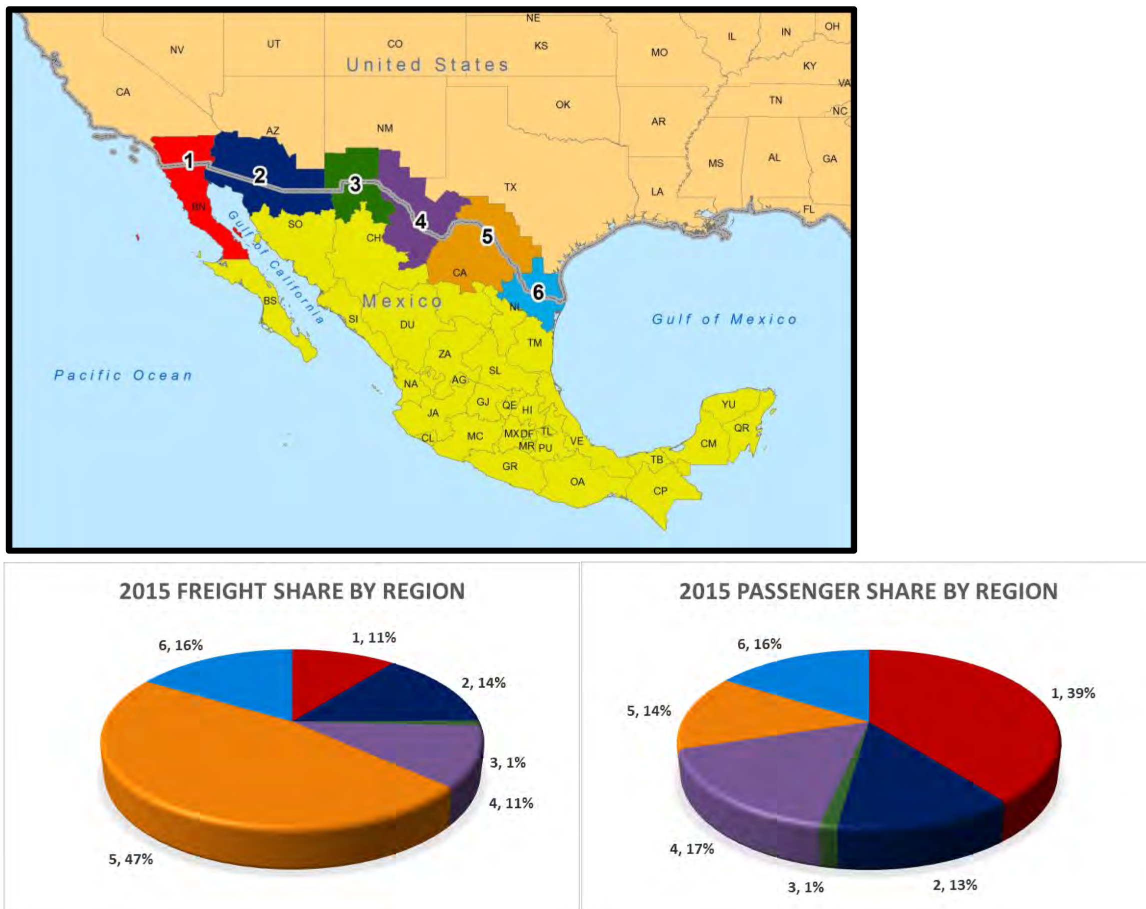


Figure 7-1 2015 Freight and Passenger Shares by Regions US-Mexico

Source: FHWA's Freight Analysis Framework 4 and Bureau of Transportation Statistics Border Crossing/Entry Data

7.4.1.1 Modal Considerations

Table 7-4 shows the mode split of freight tonnage traveling between the US and Mexico. This information is provided for all movements occurring between the two nations and also for those movements occurring specifically along the border region. Though water-borne freight makes up the largest share of goods traveling between the US and Mexico, it is the overland modes of truck, rail, and pipeline that show the greatest influence along the border.

Table 7-4 2015 Freight Tonnage by Mode US-Mexico Trade

Mode	National		Border Region	
	Thousand Tons	Split	Thousand Tons	Split
Truck	81,287	33.0%	81,287	59.0%
Rail	37,563	15.2%	37,563	27.3%
Water	109,052	44.2%	396	0.3%
Air (include truck-air)	129	0.1%	11	0.0%
Multiple modes & mail	749	0.3%	748	0.5%
Pipeline	16,971	6.9%	16,971	12.3%
Other and unknown	859	0.3%	849	0.6%

Table 7-5 shows the freight crossing modal shares with respect to tonnage along the US-Mexico border by region. Though truck tonnages make up the largest share in each region, freight movement by mode is fairly diverse in all regions except for Region 3, where truck movement accounts for 95% of all freight tonnage crossings. Rail plays a particularly large role in moving freight across the borders in Regions 2, 4, and 5. These regions serve as key gateways allowing rail freight to easily connect to each country's rail networks, with fairly direct access into and out of central Mexico. Region 2 serves rail traffic heading to the US pacific coast while Regions 4 and 5 provide access to the US Midwest and east coast.

Table 7-5 2015 Freight Mode Share by Region

Units	Region	Air (include truck-air)	Multiple modes & mail	Other and unknown	Pipeline	Rail	Truck	Water
Thousand Tons	**1**	0	132	410	2,107	366	11,572	15
	2	0	59	59	1,310	7,822	10,305	0
	3	<1	7	52	0	0	1,241	0
	4	1	76	76	2,984	4,059	7,967	0
	5	9	452	194	1,549	23,495	38,858	0
	6	<1	0	45	9,014	1,834	11,369	385
Percent Split	**1**	*0.0%*	*0.9%*	*2.8%*	*14.4%*	*2.5%*	*79.1%*	*0.1%*
	2	*0.0%*	*0.3%*	*0.3%*	*6.7%*	*40.0%*	*52.7%*	*0.0%*
	3	*<0.1%*	*0.5%*	*4.0%*	*0.0%*	*0.0%*	*95.4%*	*0.0%*
	4	*<0.1%*	*0.5%*	*0.5%*	*19.7%*	*26.8%*	*52.6%*	*0.0%*
	5	*<0.1%*	*0.7%*	*0.3%*	*2.4%*	*36.4%*	*60.2%*	*0.0%*
	6	*<0.1%*	*0.0%*	*0.2%*	*39.8%*	*8.1%*	*50.2%*	*1.7%*

Table 7-6 lists scenario specific freight tonnages by mode for the US-Mexico border.

Table 7-6 Freight Movements by Mode and by Scenario for US-Mexico Border

Scenario	Mode	Thousands of Tons						
		2015	2020	2025	2030	2035	2040	**2045**
Naftastique	Air	129	228	368	442	486	581	650
	Multiple	749	1,326	1,986	2,288	2,419	2,650	2,924
	Unknown	859	1,527	2,391	2,826	3,058	3,469	3,983
	Pipeline	16,971	24,957	37,023	38,537	36,315	37,428	39,956
	Rail	37,563	58,417	89,593	99,921	100,344	108,446	118,657
	Truck	81,287	137,766	213,304	245,172	257,561	286,840	322,622
	Water	109,052	157,634	219,138	228,578	217,758	223,018	234,238
Global Marketplace	Air	129	168	220	279	359	486	597
	Multiple	751	932	1,145	1,399	1,735	2,217	2,714
	Unknown	859	1,093	1,390	1,734	2,191	2,857	3,610
	Pipeline	16,915	19,510	23,048	25,323	27,950	31,959	37,066
	Rail	37,515	43,754	54,176	63,953	75,343	92,548	111,226
	Truck	81,272	100,939	126,438	153,411	188,391	239,461	295,827
	Water	109,093	115,494	131,469	146,037	163,975	192,076	221,886
One World Order	Air	129	160	198	240	296	388	460
	Multiple	748	883	1,023	1,186	1,405	1,728	2,041
	Unknown	858	1,041	1,248	1,479	1,790	2,250	2,741
	Pipeline	17,028	18,850	20,966	21,976	23,349	25,845	28,925
	Rail	37,611	41,950	48,955	55,007	62,169	73,722	85,480
	Truck	81,303	96,478	113,936	131,445	154,704	189,701	226,127
	Water	109,010	110,070	118,103	124,768	134,413	152,207	169,817
Millions of Markets	Air	129	166	210	262	326	428	509
	Multiple	749	930	1,112	1,326	1,569	1,927	2,275
	Unknown	859	1,087	1,342	1,639	1,986	2,497	3,045
	Pipeline	16,971	19,186	21,715	23,640	25,470	28,345	31,826
	Rail	37,563	43,277	51,661	60,081	68,455	81,395	94,563
	Truck	81,287	100,112	121,284	144,556	170,986	209,959	250,634
	Water	109,052	114,641	126,096	137,405	148,628	168,430	188,152

Table 7-7 shows the mode split of passengers traveling between the US and Mexico. This information is provided both for all movements occurring between the two nations and also for those movements occurring specifically within the border regions. Automobiles make up the largest share of border crossings, both nationally and within the border region, while train travel is the least significant. Air makes up a significant portion of travel between the two countries nationally, but not within the border area itself. These trips are predominantly longer distance and may have points of origin and destination well within the interior of each country, by-passing the border region entirely.

Table 7-7 2015 Passenger Crossings by Mode US-Mexico Border

Mode	National		Border Region	
	Daily Passengers	Split	Daily Passengers	Split
Train	61	<0.1%	61	<0.1%
Bus	15,900	1.6%	15,900	1.6%
Auto	736,761	69.2%	736,761	74.6%
Pedestrian	235,029	23.3%	235,029	23.8%
Air	61,931	5.9%	0	0.0%

Table 7-8 shows the passenger crossing mode shares within each region along the US-Mexico border. Though the largest percentage of border crossings across all regions occurs by automobile, there is a significant number of crossings occurring by foot. Pedestrians make up approximately 18% to nearly 28% percent of all individuals crossing the border. This demand is consistent and unlikely to change unless actions are taken to restrict the ease with which pedestrians cross. Communities along the US-Mexico border should expect pedestrian and bicycle travel to increase or decrease with the general trends expressed in these scenarios. Planning considerations involving bicycle and pedestrian infrastructure, safety, and access to public transport are a greater concern along the US-Mexico border than they are along the US-Canada border, where only Region 10 has a pedestrian share as high as 1.1% and all others are well below that.

Table 7-8 2015 Passenger Mode Share by Region

Units	Region	Train	Bus	Auto	Pedestrian
Daily Passengers	**1**	4	4,565	283,317	102,025
	2	17	1,019	89,934	34,677
	3	0	112	10,042	2,598
	4	40	1,902	123,344	39,392
	5	0	6,013	104,828	25,311
	6	0	2,289	125,296	31,027
Percent Split	**1**	*<0.1%*	*1.2%*	*72.7%*	*26.2%*
	2	*<0.1%*	*0.8%*	*71.6%*	*27.6%*
	3	*0.0%*	*0.9%*	*78.8%*	*20.4%*
	4	*<0.1%*	*1.2%*	*74.9%*	*23.9%*
	5	*0.0%*	*4.4%*	*77.0%*	*18.6%*
	6	*0.0%*	*1.4%*	*79.0%*	*19.6%*

7.4.1.2 Additional Scenario-Based Results

Naftastique - Mexico

Figure 7-2 shows a graph of annual overland freight crossings by region for the Naftastique scenario. This scenario shows freight crossings increasing significantly between 2015 and 2025 as the barriers to trade (as described in the scenario) fall. Growth then gradually slows down once that process matures, though it remains positive.

While all regions experience the general trend, the effects are more apparent for Region 5. As Naftastique represents a scenario with extremely open borders for both freight and person movements, this should not be surprising. Region 5 will experience magnified impacts from this scenario as the principal gateway for freight traffic across the border.

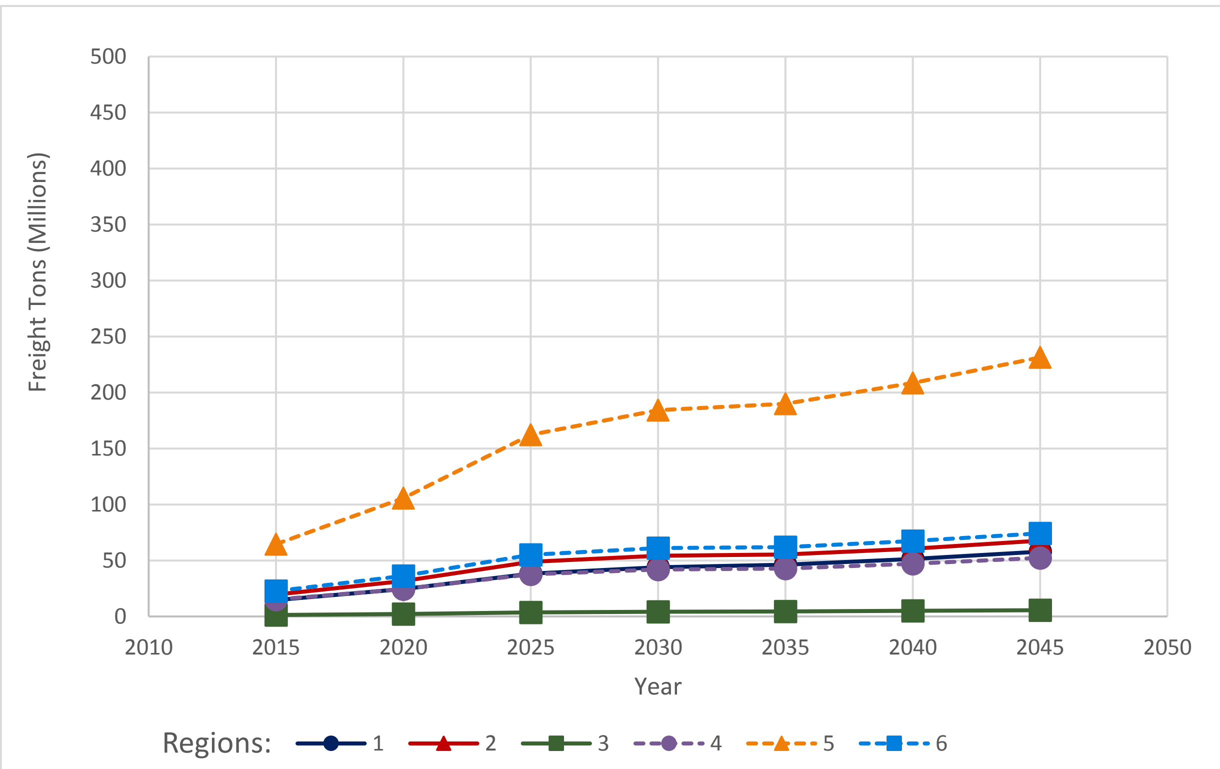


Figure 7-2 Freight Crossings by Region 2015-2045 Naftastique

Source: Results from Scenario Planning of Future Freight and Passenger Traffic Flows across the US/Mexico and US/Canada Borders

Figure 7-3 shows a similar graph for daily passenger crossings for the Naftastique scenario. The trend here is generally toward positive growth in crossings. The impacts of Naftastique are expected to have a tremendous impact on US-Mexico border crossings. Robust economic growth and reduced levels of unemployment for all countries resulting from mostly open borders allow the larger border communities to integrate with each other in unprecedented ways. With the freedom to find work and access markets without impedance, movement across the border occurs freely. Those communities with particularly large populations and a long standing history of cross-border cultural engagement see the greatest impact, with border crossings doubling or even tripling from their present values.

Under this scenario, communities such as San Diego and Tijuana, and El Paso and Ciudad Juarez essentially become twin city metropolises without significant distinction. It is unlikely that the existing border crossing infrastructure could sustain this level activity.

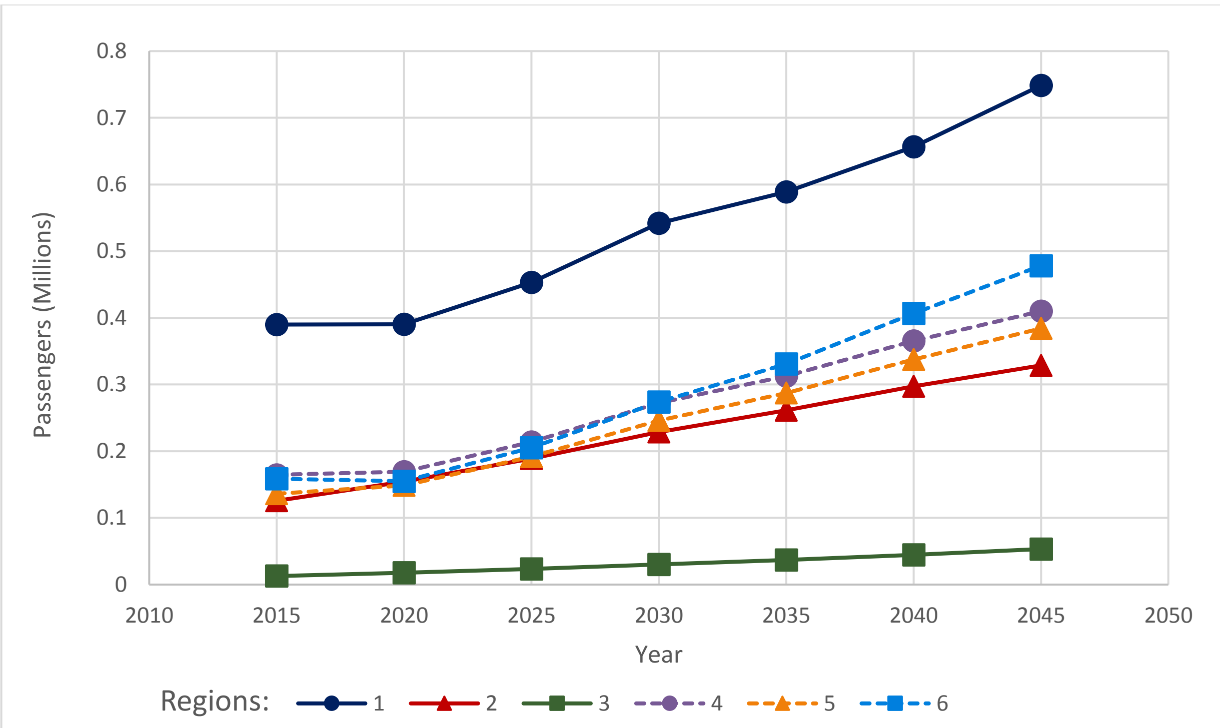


Figure 7-3 Daily Passenger Crossings by Region 2015-2045 Naftastique

Source: Results from Scenario Planning of Future Freight and Passenger Traffic Flows across the US/Mexico and US/Canada Borders

One World Order – Mexico

Figure 7-4 shows a graph of annual overland freight crossings by region for the One World Order scenario. This scenario shows freight crossings increasing slightly between 2015 and 2045. While all regions experience the general trend, the effects are more apparent for Region 5. As One World Order represents a scenario with restricted borders and highly regulated trade policies this should not be surprising. Trade growth is still positive, although much slower than the baseline. This is due to the scenario itself, which indicates a growing economy and freight ton-miles decreasing. This would seem to imply some level of "nearsourcing,"[7] where overseas trade may be decreasing while cross-border trade is still positive.

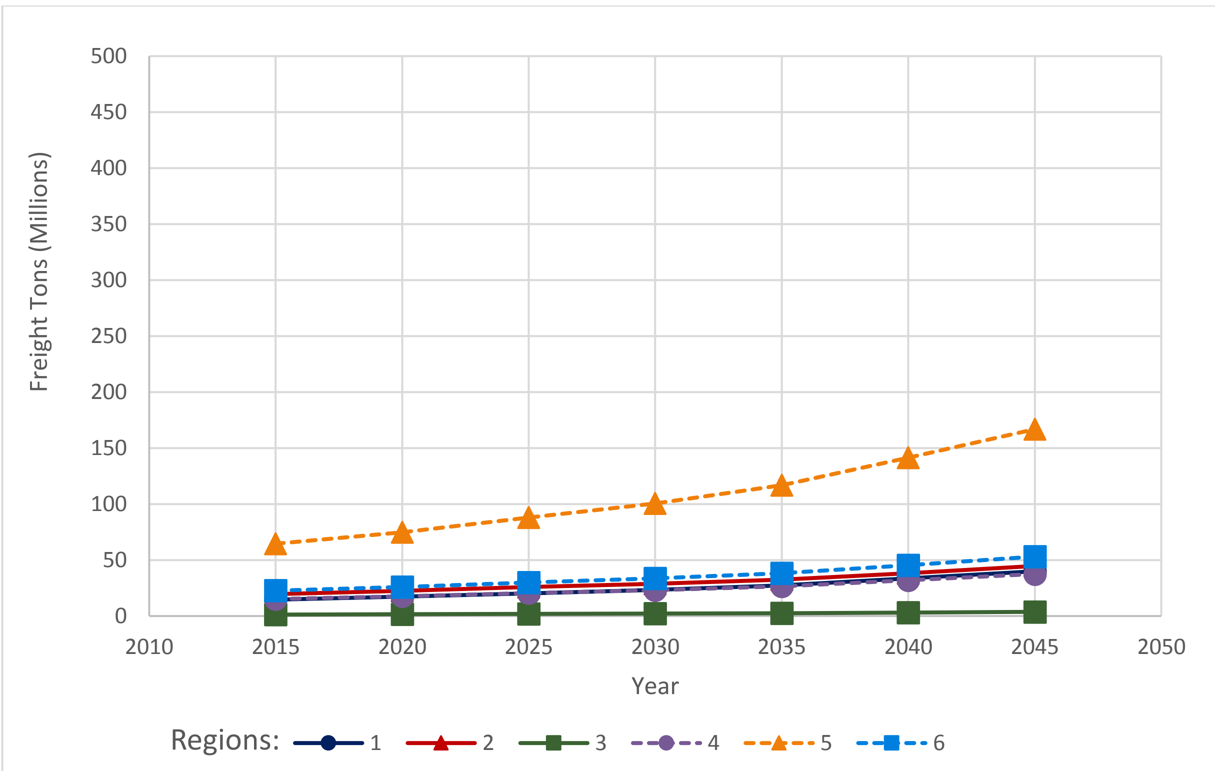


Figure 7-4 Annual Freight Crossings by Region 2015-2045 One World Order

Source: Results from Scenario Planning of Future Freight and Passenger Traffic Flows across the US/Mexico and US/Canada Borders

[7] "Nearsourcing" is a process by which materials to be consumed are acquired from locations close to market. This reduces the amount of transportation required to move goods to market.

Figure 7-5 shows a graph for daily passenger crossings for the One World Order scenario, which generally trends toward negative growth in crossings. Given the dynamic nature of the interaction between communities along the US-Mexico border, the impacts of the most extreme scenarios have a dramatic effect in these regions. Regions 1, 4, and 6 see dramatic reductions in border crossings, reasserting a decade-long trend from the recession of 2001 to the post-Great Recession recovery starting in 2011. In this scenario, any gains made from the recovery are undone and the negative growth continues. While there is still noticeable economic growth in all regions, unemployment rates increase after an initial period of decrease, ending at approximately one percentage point higher than present values.

The real driver of the reduction in border crossings in this scenario stems from significantly increased fuel prices arising from centrally regulated controls. These high prices discourage travel, and the lack of robust growth in the regional economies fails to overcome this downward pressure. Regions 2 and 5 do experience a period of steady growth until the negative trend in crossings takes over in later years; this is primarily due to the two regions' lesser sensitivities to fuel prices. Despite this, by 2045 prices will be sufficiently high enough to cause crossings to decline. Only Regions 2 and 3 experience enough growth in border crossings to surpass the highest volume of crossings observed in the data from 1995 to 2014; all other regions are below the high volume points recorded during the late 1990s.

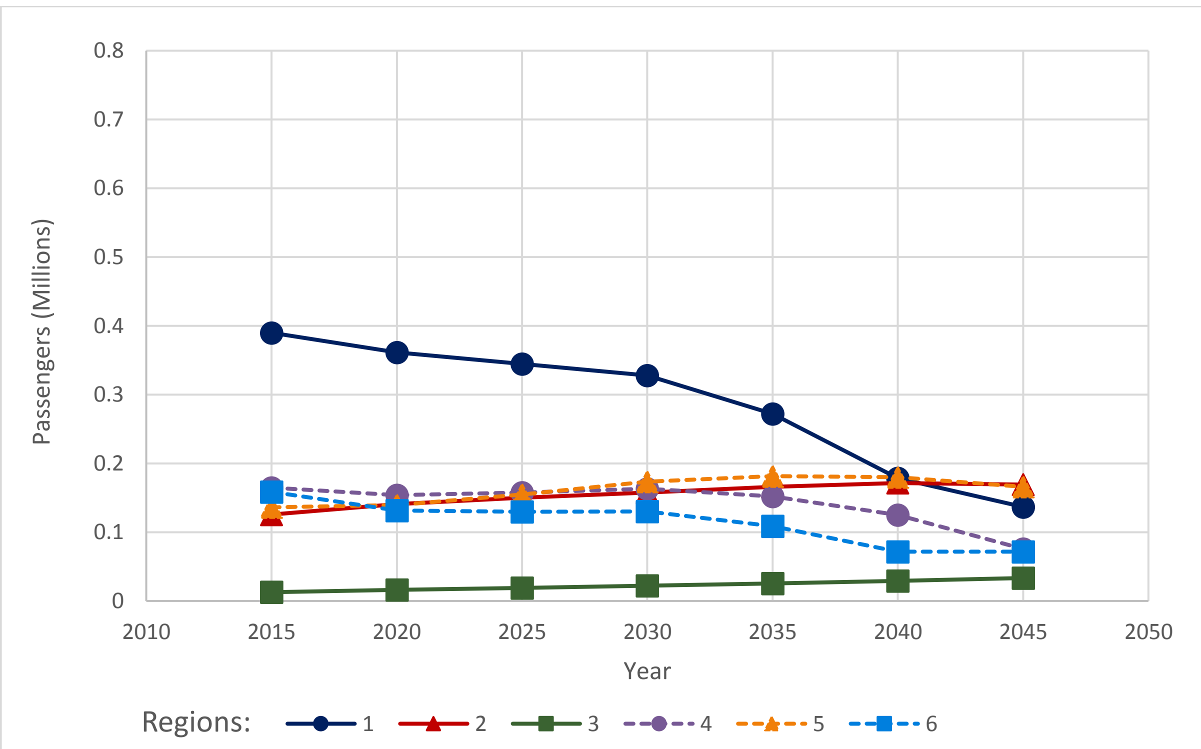


Figure 7-5 Daily Passenger Crossings by Region 2015-2045 One World Order

Source: Results from Scenario Planning of Future Freight and Passenger Traffic Flows across the US/Mexico and US/Canada Borders

Global Marketplace – Mexico

Figure 7-6 shows a graph of annual overland freight crossings by region for the Global Marketplace scenario, which shows an increase in freight crossings between 2015 and 2045. While all regions experience the general trend, the effects are again more apparent for the Region 5 crossings. In this high trade growth scenario, the expected 2040 trade tonnage matches very closely with the 2040 tonnage in the Naftastique scenario. The difference here is that the growth is much more gradual, as there are not the same open border agreements that would take place in the early part of the forecast.

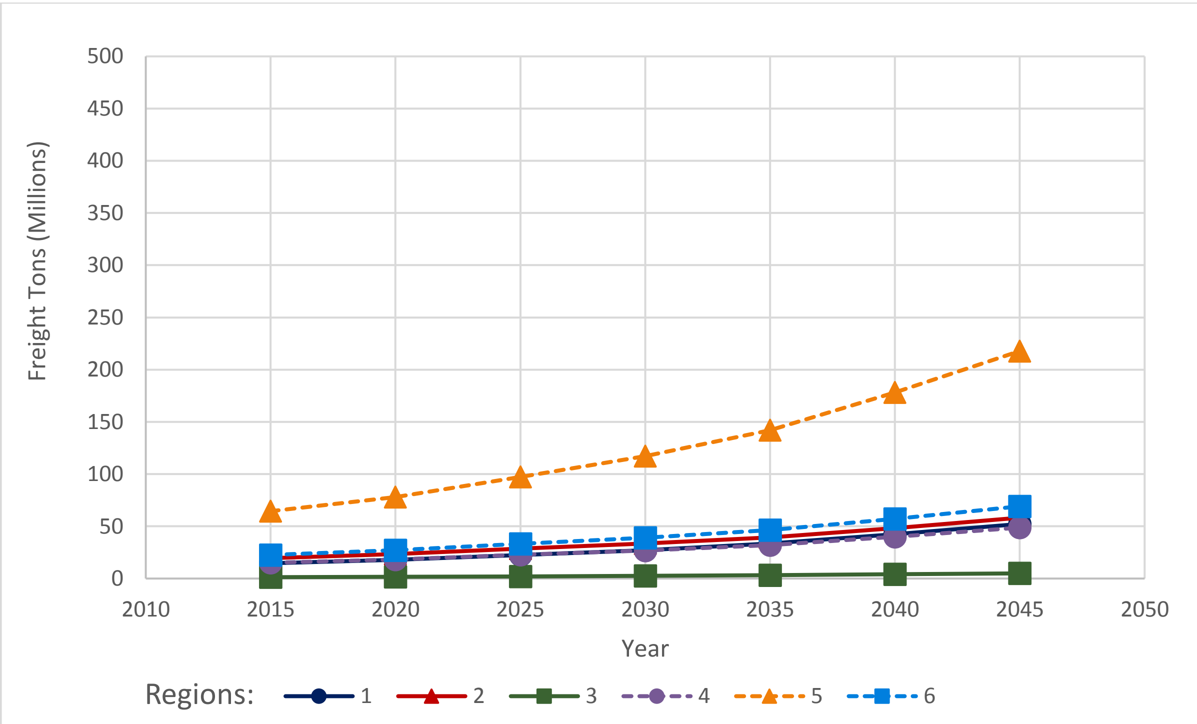


Figure 7-6 Annual Freight Crossings by Region 2015-2045 Global Marketplace

Source: Results from Scenario Planning of Future Freight and Passenger Traffic Flows across the US/Mexico and US/Canada Borders

Figure 7-7 shows a graph for daily passenger crossings for the Global Marketplace scenario. The trend here is generally toward positive growth in crossings. Growth in crossings disproportionately favors Regions 1 and 4. In the case of Region 1, close proximity to Los Angeles as a significant global trade port allows the region to realize the benefits of highly increased economic activity that generate wealth and encourage people on both sides of the border to travel extensively across the border. Demand will be high in this scenario, rivaling the Naftastique scenario in terms of volume and straining the existing infrastructure. Region 4 is also better positioned than its neighbors to capture the benefits of a more technologically driven and dynamic market. Only Region 6 will fail to surpass historic highs in terms of border crossings. All other regions will experience significant growth in crossings, though in most cases not to the same extent as in Naftastique.

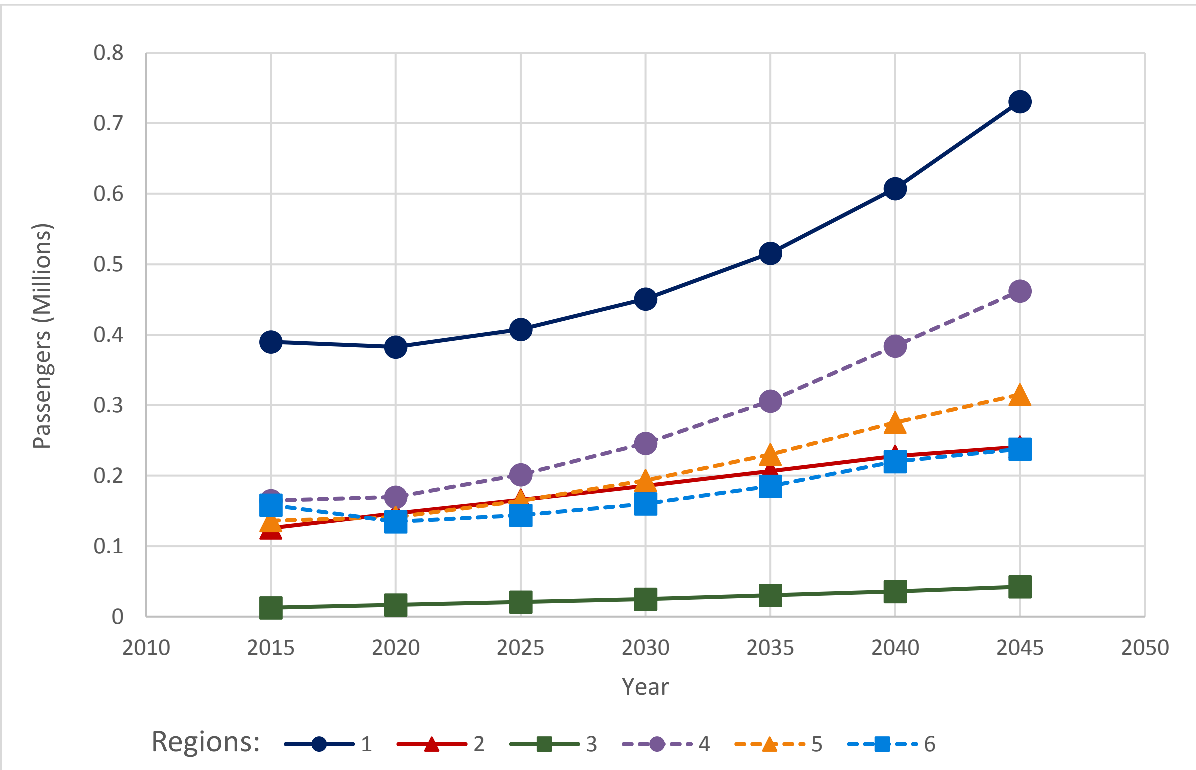


Figure 7-7 Daily Passenger Crossings by Region 2015-2045 Global Marketplace

Source: Results from Scenario Planning of Future Freight and Passenger Traffic Flows across the US/Mexico and US/Canada Borders

Millions of Markets – Mexico

Figure 7-8 shows a graph of annual overland freight crossings by region for the Millions of Markets scenario. This scenario shows modest increases in freight crossings between 2015 and 2045. While all regions experience the general trend, the effects are more apparent for Region 5. This scenario is the most similar to the baseline FAF4 forecast, given that the GDP and trade growth numbers provided by the scenario are close to what was used to develop the FAF4 forecast. Differences become more pronounced when looking at individual lanes and the overall balance of trade.

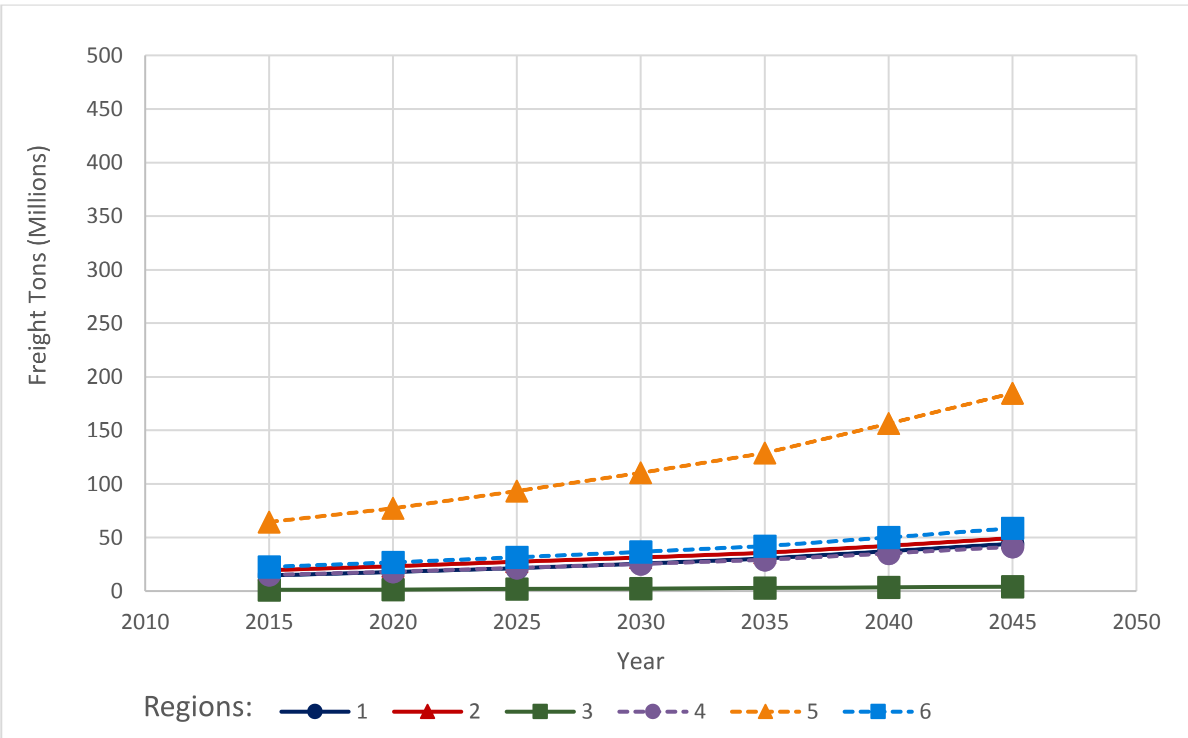


Figure 7-8 Annual Freight Crossings by Region 2015-2045 Millions of Markets

Source: Results from Scenario Planning of Future Freight and Passenger Traffic Flows across the US/Mexico and US/Canada Borders

Figure 7-9 shows a graph for daily passenger crossings for the Millions of Markets scenario, trending toward flat growth in crossings with some regions decreasing. With highly localized manufacturing and goods distribution, the need to traverse the border to engage in business or recreation diminishes. Economic growth slows down as trade is no longer global in scope, and economies of scale and dynamic trading in key hubs are no longer emphasized. Cheap fuel and low unemployment keep most regions interacting at the status-quo, but the lack of significant migration to the border keeps activity levels low. Only Region 3 increases above historic highs in the number of crossings; the relatively low levels of crossings and low population densities make this area less volatile than other regions, and therefore less responsive to the effects of each scenario than other regions along the border.

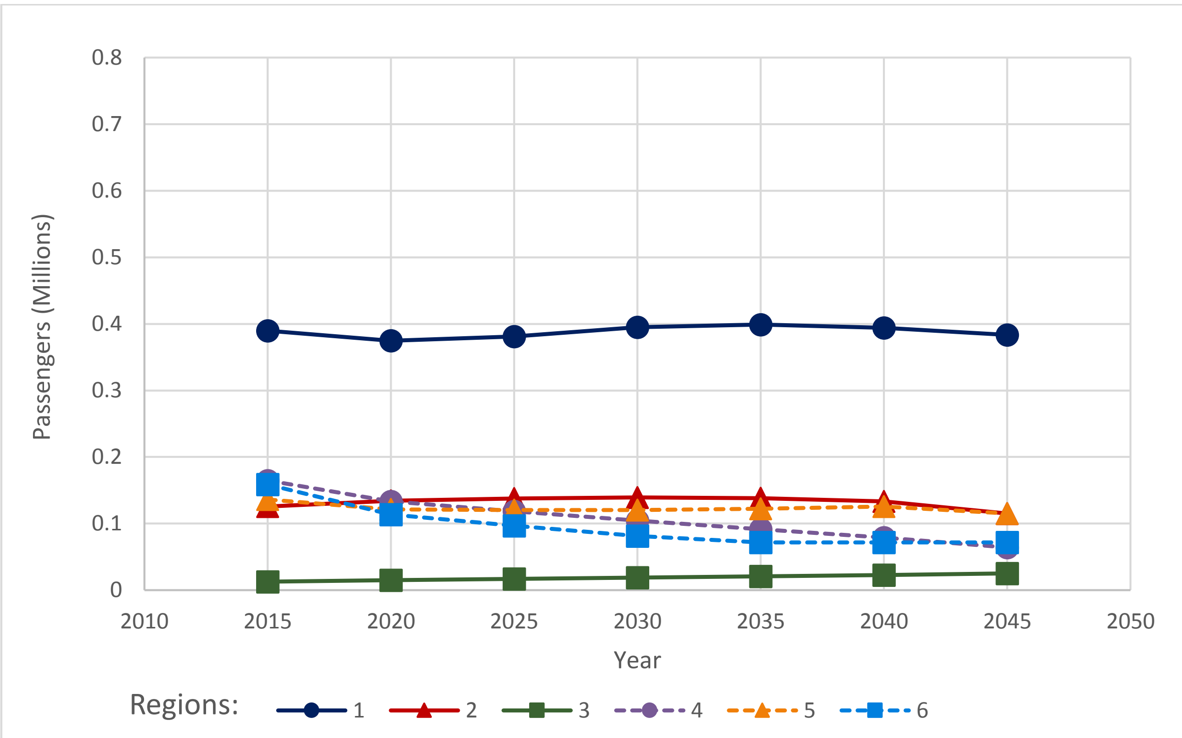
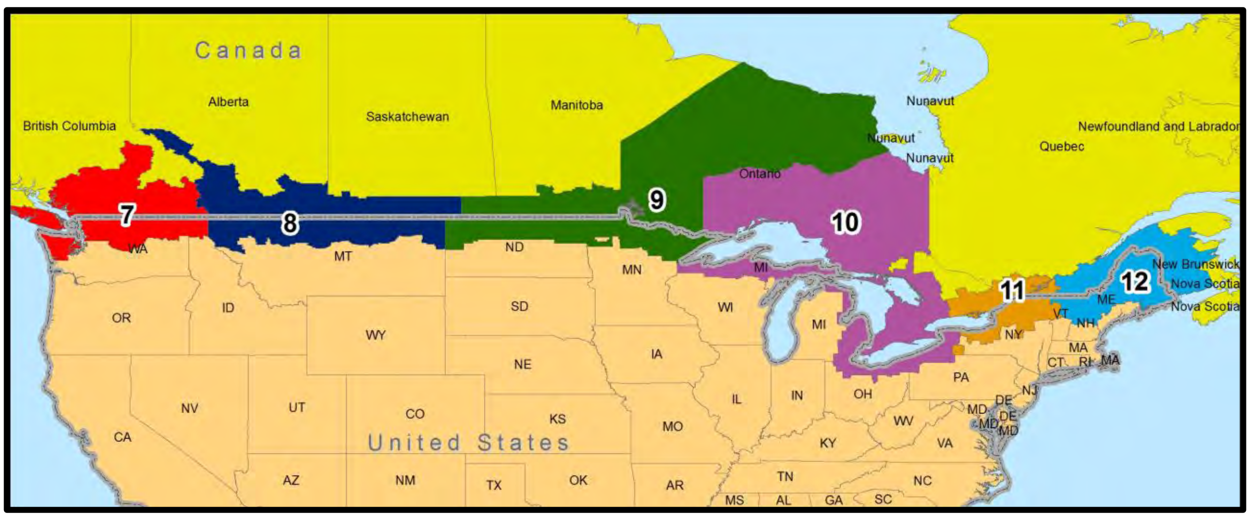


Figure 7-9 Daily Passenger Crossings by Region 2015-2045 Millions of Markets

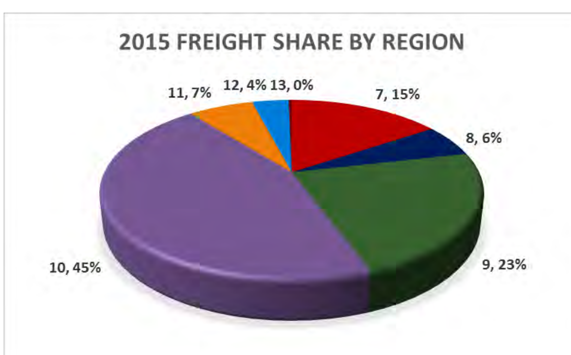
Source: Results from Scenario Planning of Future Freight and Passenger Traffic Flows across the US/Mexico and US/Canada Borders

7.4.2 US-Canada Results

Figure 7-10 shows the 2015 shares of passengers and freight along the US-Canada border, by regions, based on the BTS Border Crossing/Entry Data. The information in the pie charts identifies the region number and the percent share of crossings, illustrating that Region 10 has the largest share of both passengers and freight. This region includes the most densely populated urban areas along the US-Canada border, such as Detroit and Toronto. Region 9, while without large population centers near the border, has heavily used freight rail crossings for both Canadian National and Canadian Pacific railroads. The next highest volume of passenger crossings is Region 7, another fairly densely populated border region with close proximity to Vancouver, BC and Seattle, WA. The amount of passenger border crossings correlates fairly positively with larger population centers; the principal exception to this being Region 11. This region shows a smaller share of border crossings than neighboring Region 12, despite the fact that Region 11 is home to Montreal. This is likely because the presence of numerous smaller communities in Region 12 along Maine's frontier near Madawaska, Houlton, and Calais allow entry to the US from New Brunswick. Additionally, the I-89 border crossing in Highgate Springs (in Region 12) allows an alternative point of access from the greater Montreal metropolitan area which could draw some of the traffic that would otherwise be captured in Region 11.



(Not shown on the map, Region 13 is Alaska/Canada border)



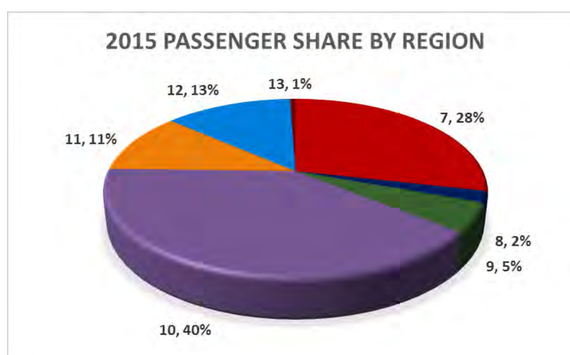


Figure 7-10 2015 Freight and Passenger Shares by Regions along the US-Canada Border

Source: FHWA's Freight Analysis Framework 4 and Bureau of Transportation Statistics Border Crossing/Entry Data

7.4.2.1 Modal Considerations

Table 7-9 shows the mode split of freight tonnage traveling between the US and Canada. This information is provided for all movements occurring between the two nations and also for those movements occurring specifically along the border regions. National freight movements show a near-even split between truck, rail, and water, with pipeline comprising the largest share of freight. Along the border, the role of water-borne freight diminishes but is still significant due to trade across the Great Lakes.

Table 7-9 Freight Tonnage by Mode US-Canada Trade

Mode	National Thousand Tons	Split	Border Region Thousand Tons	Split
Truck	128,718	22.3%	115,121	34.1%
Rail	104,191	18.0%	89,187	26.4%
Water	110,432	19.1%	32,858	9.7%
Air (include truck-air)	230	0.0%	108	0.0%
Multiple modes & mail	9,692	1.7%	6,542	1.9%
Pipeline	224,520	38.8%	93,353	27.7%
Other and unknown	438	0.1%	355	0.1%

Table 7-10 shows the mode split of passengers traveling between the US and Canada. This information is provided for all movements occurring between the two nations and also for those movements occurring specifically within the border region. Automobiles make up the largest share of border crossings, both nationally and within the border region, while train travel is the least significant. Air makes up the second largest of travel between the two countries nationally, but not within the border area itself. These trips are predominantly longer distance and may have points of origin and destination well within the interior of each country, by-passing the border region entirely. Unlike the US-Mexico border, pedestrian travel is not a significant portion of border crossing trips.

Table 7-10 Passenger Crossings by Mode US-Canada Border

Mode	National Daily Passengers	Split	Border Region Daily Passengers	Split
Train	1,463	0.4%	1,463	0.4%
Bus	12,355	3.0%	12,355	3.5%
Auto	340,255	79.9%	340,255	95.5%
Pedestrian	2,393	0.5%	2,393	0.7%
Air	68,911	16.2%	0	0.0%

Table 7-11 shows the freight tonnage mode shares for regions along the US-Canada border. Freight modes are highly diversified, with trucks making up a majority of all freight travel only in Regions 11 and 12. Rail and pipeline are very well represented among the seven regions. Water-borne freight is a key component of Regions 7, 10, and especially 13.

Table 7-11 2015 Freight Tonnage Mode Share by Region

Unit	Region	Air (include truck-air)	Multiple modes & mail	Other and unknown	Pipeline	Rail	Truck	Water
Thousand Tons	**7**	12	2,133	41	25,835	15,000	13,564	5,663
	8	2	205	19	14,984	2,019	6,150	0
	9	6	816	14	36,373	40,877	13,704	0
	10	95	4,452	234	34,630	39,449	70,514	30,200
	11	4	554	54	4,302	4,546	15,420	1,711
	12	1	416	34	3,063	2,294	9,140	3
	13	1	100	1	0	2	194	944
Percent Split	**7**	*0.0%*	*3.4%*	*0.1%*	*41.5%*	*24.1%*	*21.8%*	*9.1%*
	8	*0.0%*	*0.9%*	*0.1%*	*64.1%*	*8.6%*	*26.3%*	*0.0%*
	9	*0.0%*	*0.9%*	*0.0%*	*39.6%*	*44.5%*	*14.9%*	*0.0%*
	10	*0.1%*	*2.5%*	*0.1%*	*19.3%*	*22.0%*	*39.3%*	*16.8%*
	11	*0.0%*	*2.1%*	*0.2%*	*16.2%*	*17.1%*	*58.0%*	*6.4%*
	12	*0.0%*	*2.8%*	*0.2%*	*20.5%*	*15.3%*	*61.1%*	*0.0%*
	13	*0.0%*	*8.0%*	*0.1%*	*0.0%*	*0.2%*	*15.6%*	*76.0%*

Table 7-12 lists scenario specific freight tonnages by mode for the US-Canada border.

Table 7-12 Freight Movements by Mode and by Scenario for US-Canada Border

Scenario	Mode	Thousands of Tons						
		2015	2020	2025	2030	2035	2040	**2045**
Naftastique	Air	230	389	654	751	871	1,058	1,196
	Multiple	9,692	14,880	22,736	24,434	26,605	29,376	32,744
	Unknown	438	696	1,089	1,245	1,456	1,699	1,945
	Pipeline	224,520	309,850	385,707	389,572	396,844	383,094	386,039
	Rail	104,191	146,504	201,822	213,225	232,246	245,255	266,497
	Truck	128,718	193,904	290,346	312,894	342,759	376,246	419,011
	Water	110,432	146,850	188,704	181,340	176,929	172,341	173,196
Global Marketplace	Air	230	297	394	495	631	851	1,052
	Multiple	9,679	11,652	14,371	16,997	20,330	25,213	30,772
	Unknown	438	559	721	900	1,136	1,486	1,863
	Pipeline	225,021	262,571	284,067	312,039	335,299	366,290	402,735
	Rail	104,299	120,972	141,077	162,936	189,910	226,561	269,210
	Truck	128,644	154,309	188,632	222,832	266,066	327,928	399,625
	Water	110,405	118,232	125,807	132,761	141,098	155,219	171,391
One World Order	Air	231	286	358	429	527	689	821
	Multiple	9,706	11,183	12,998	14,636	16,806	20,131	23,712
	Unknown	438	535	650	771	934	1,179	1,426
	Pipeline	224,017	248,634	253,304	263,581	270,368	284,087	301,128
	Rail	104,083	115,048	126,412	138,557	154,475	177,511	203,422
	Truck	128,793	147,692	170,196	191,317	219,189	260,907	306,893
	Water	110,458	112,864	113,040	113,340	115,413	122,448	130,378
Millions of Markets	Air	230	293	373	464	576	755	903
	Multiple	9,692	11,520	13,694	15,963	18,483	22,203	26,206
	Unknown	438	555	692	848	1,032	1,304	1,580
	Pipeline	224,520	262,027	275,731	295,349	302,492	317,394	336,497
	Rail	104,191	120,347	136,134	153,877	171,824	197,430	226,428
	Truck	128,718	152,851	180,370	209,576	241,643	288,212	339,589
	Water	110,432	117,228	120,463	124,822	127,770	135,770	144,782

Table 7-13 shows passenger mode share by region along the US-Canada border. Unlike the US-Mexico border, the modal split along the US-Canada border overwhelmingly favors the automobile. Only Region 10 shows pedestrian traffic, in excess of just 1% due to recreational border crossings at Niagara Falls. Buses play a more significant role along the US-Canada border, reaching 6.1 % of all annual passenger crossings in Region 11. Any future border crossing impacts to the transportation system will primarily occur on the highway system; some demand for higher capacity transportation such as bus and rail may also be possible. Region 13 is distinct in that bus and rail make up much larger shares of the border crossings, due to the much longer distances border crossers need to travel to reach their destinations. For US travelers from the lower 48 states wishing to travel to Alaska by land, bus or rail may be a more attractive alternative than driving the vast distances themselves.

Table 7-13 2015 Mode Share by Region

Unit	Region	Train	Bus	Auto	Pedestrian
Daily Passengers	7	478	2,092	98,623	515
	8	11	82	7,180	23
	9	127	425	18,062	104
	10	221	5,357	134,150	1,518
	11	279	2,410	36,562	13
	12	21	1,229	44,818	212
	13	326	761	860	8
Percent Split	7	*0.5%*	*2.1%*	*97.0%*	*0.5%*
	8	*0.2%*	*1.1%*	*98.4%*	*0.3%*
	9	*0.7%*	*2.3%*	*96.5%*	*0.6%*
	10	*0.2%*	*3.8%*	*95.0%*	*1.1%*
	11	*0.7%*	*6.1%*	*93.1%*	*0.0%*
	12	*0.0%*	*2.7%*	*96.8%*	*0.5%*
	13	*16.7%*	*38.9%*	*44.0%*	*0.4%*

7.4.2.2 Additional Scenario-Based Results

Naftastique - Canada

Figure 7-11 shows a graph of annual freight crossings by region for the Naftastique scenario, which shows overland freight crossings increasing significantly between 2015 and 2025. Growth then gradually slows down, though it remains positive. While all regions experience the general trend, the effects are more apparent in Region 10; this is not surprising as Naftastique represents a scenario with extremely open borders for both freight and person movements. The freer movements across the border are assumed to generate an even greater level of trade between the US and Canada. Region 10, home to the historic industrial manufacturing economies of the US and Southern Ontario, stands to capture a significant share of the benefits from this scenario.

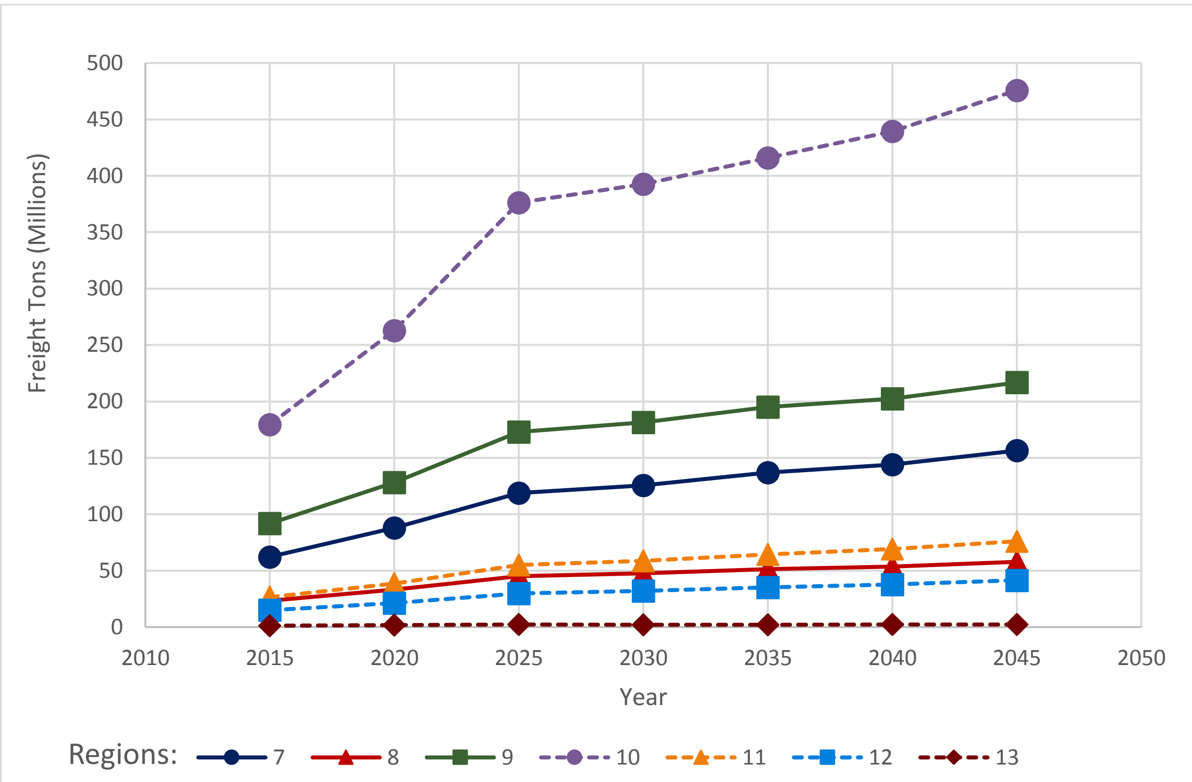


Figure 7-11 Freight Crossings by Region 2015-2045 Naftastique

Source: Results from Scenario Planning of Future Freight and Passenger Traffic Flows across the US/Mexico and US/Canada Borders

Figure 7-12 shows a similar graph for daily passenger crossings for the Naftastique scenario. The trend here is generally toward positive growth in crossings. With respect to demand, the US-Canada border is generally less affected by border crossing drivers than the US-Mexico border, perhaps because the less-populated US-Canada border produces less latent demand. Though the intensity of the impacts here is less pronounced than what is seen in the US-Mexico border regions for this scenario, growth is still significant relative to these locations. Regions 7, 10, and 11 experience significant growth under this scenario. Of particular note is Region 11, in which crossings would more than double. Regions 7 and 11 would experience higher levels of border crossings than previously observed, while Region 10, though increasing, would not exceed historic levels of border crossings. The other regions see little to no increase in border crossings.

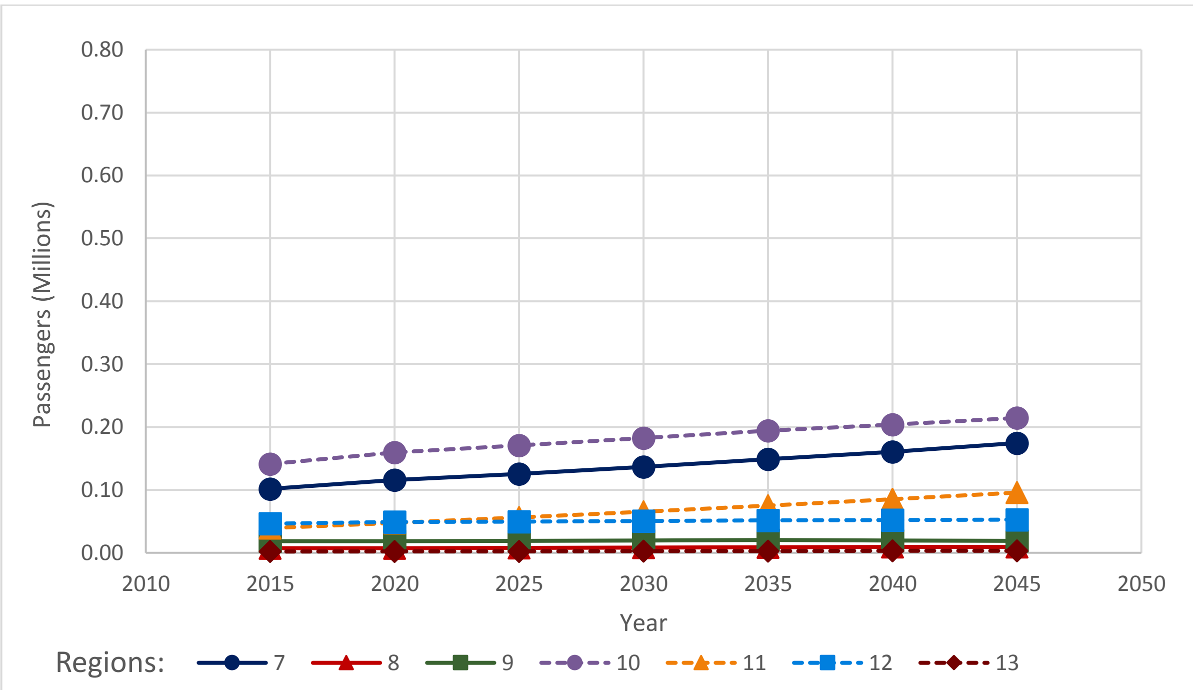


Figure 7-12 Daily Passenger Crossings by Region 2015-2045 Naftastique

Source: Results from Scenario Planning of Future Freight and Passenger Traffic Flows across the US/Mexico and US/Canada Borders

One World Order – Canada

Figure 7-13 shows a graph of annual freight crossings by region for the One World Order scenario. This scenario shows overland freight crossings increasing between 2015 and 2045. As is the case with Mexican trade, total trade growth with Canada is still positive but slower than the baseline.

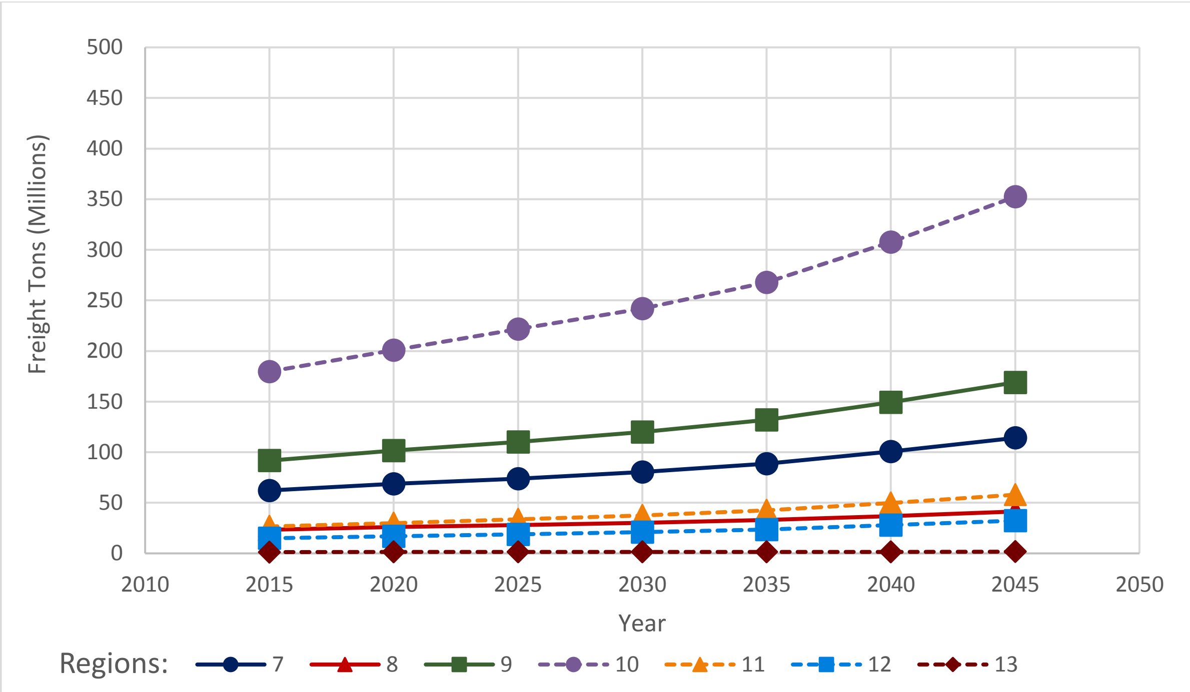


Figure 7-13 Annual Freight Crossings by Region 2015-2045 One World Order

Source: Results from Scenario Planning of Future Freight and Passenger Traffic Flows across the US/Mexico and US/Canada Borders

Figure 7-14 shows a graph for daily passenger crossings for the One World Order scenario with a trend toward negative growth in border crossings, which forms a continuity with previous trends observed in the Border Crossing/Entry data from 1995 to 2008. While Region 7 showed increases in border crossings from 2008 to 2014, all other regions tended toward a decrease in crossings. The One World Order scenario reverses the gains made in Region 7, and by 2045, regional crossings would be roughly where they would be if the upturn in border crossings had never occurred. Only Region 11 – which proved relatively insensitive to many drivers influencing border crossings in other regions, and relies heavily on population and employment growth – continues to grow in border crossings. Because population and employment continue to grow in this scenario, so do the border crossings for Region 11.

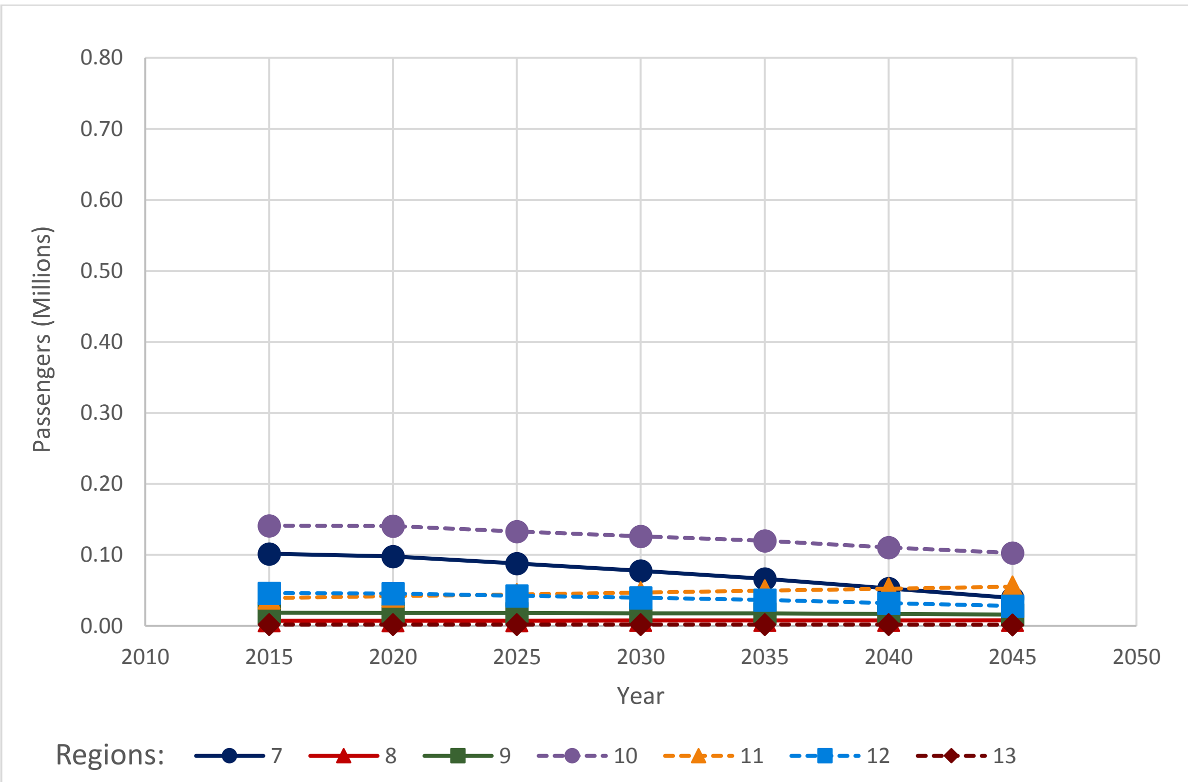


Figure 7-14 Daily Passenger Crossings by Region 2015-2045 One World Order

Source: Results from Scenario Planning of Future Freight and Passenger Traffic Flows across the US/Mexico and US/Canada Borders

Global Market Place – Canada

Figure 7-15 shows a graph of annual freight crossings by region for the Global Marketplace scenario. This scenario yields an increase in overland freight crossings between 2015 and 2045. As would be expected in a high-trade scenario, the heavily trafficked crossings in Region 10 experience the most pronounced growth.

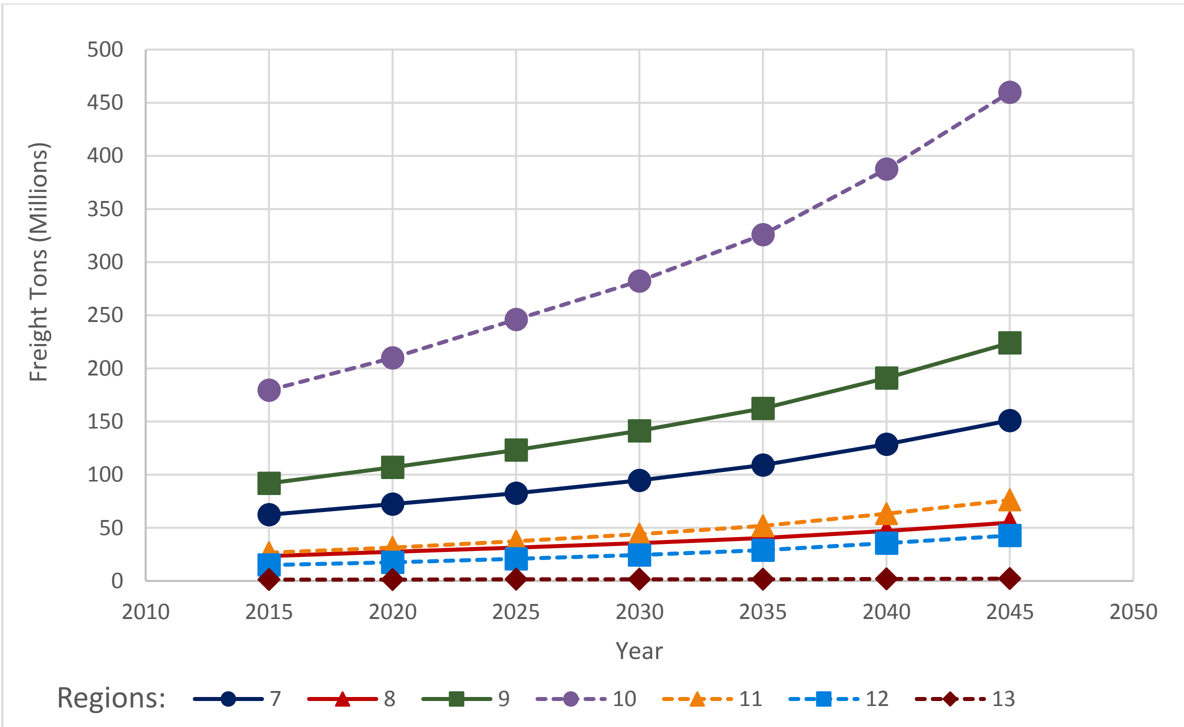


Figure 7-15 Annual Freight Crossings by Region 2015-2045 Global Marketplace

Source: Results from Scenario Planning of Future Freight and Passenger Traffic Flows across the US/Mexico and US/Canada Borders

Figure 7-16 shows a graph for daily passenger crossings for the Global Marketplace scenario, illustrating a trend toward positive growth in crossings. Rising population within the urban areas along the border, combined with a stronger Canadian dollar, induces more travel into the US by Canadian residents. As with the previous two scenarios, impacts are observed primarily in the more urbanized areas of Region 7, 10, and 11. The remaining regions see relatively little growth. Region 13 does have increases that approximately double its existing border crossings, but the volume experienced along this border, along with the large share of higher capacity modes such as rail and bus, means that future impacts should be relatively slight. Regions 7, 11, and 13 all are expected to achieve a larger number of crossings than the historical highs recorded in those regions. The other regions remain flat or are still below their highest levels despite growth, as is the case with Region 10.

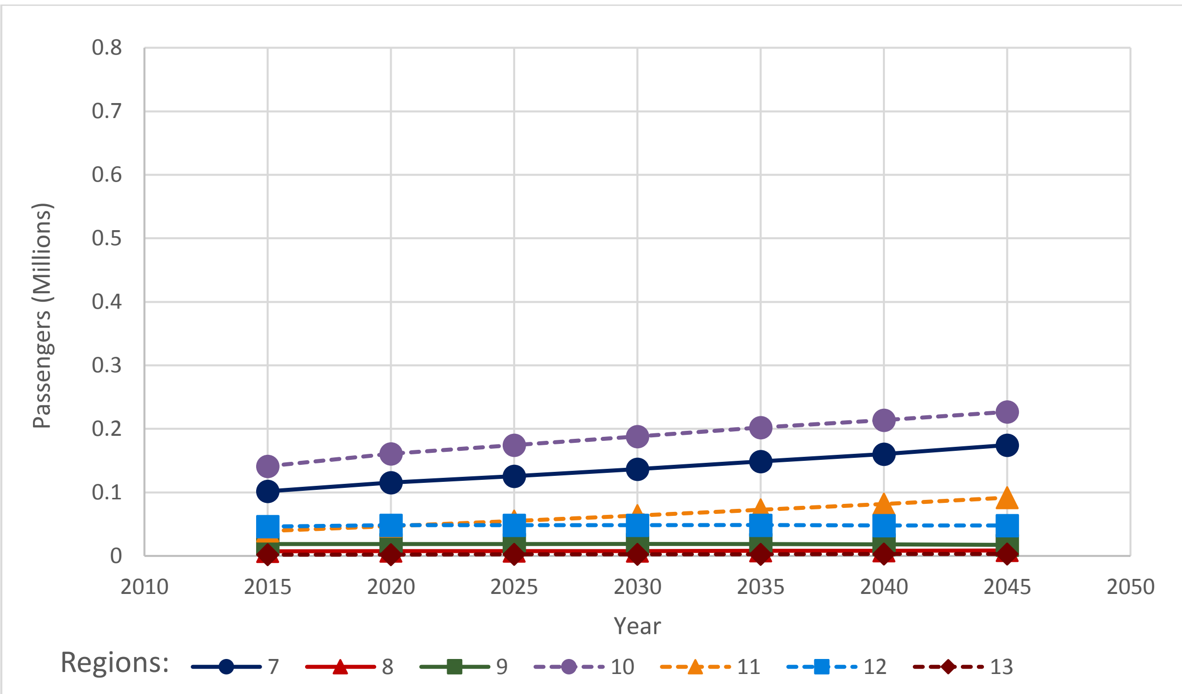


Figure 7-16 Daily Passenger Crossings by Region 2015-2045 Global Marketplace

Source: Results from Scenario Planning of Future Freight and Passenger Traffic Flows across the US/Mexico and US/Canada Borders

Millions of Markets – Canada

Figure 7-17 shows a graph of annual freight crossings by region for the Millions of Markets scenario, with an increase between 2015 and 2045. This scenario is most similar to the baseline FAF4 forecast, given that the GDP and trade growth numbers provided by the scenario are close to what was used to develop the FAF4 forecast.

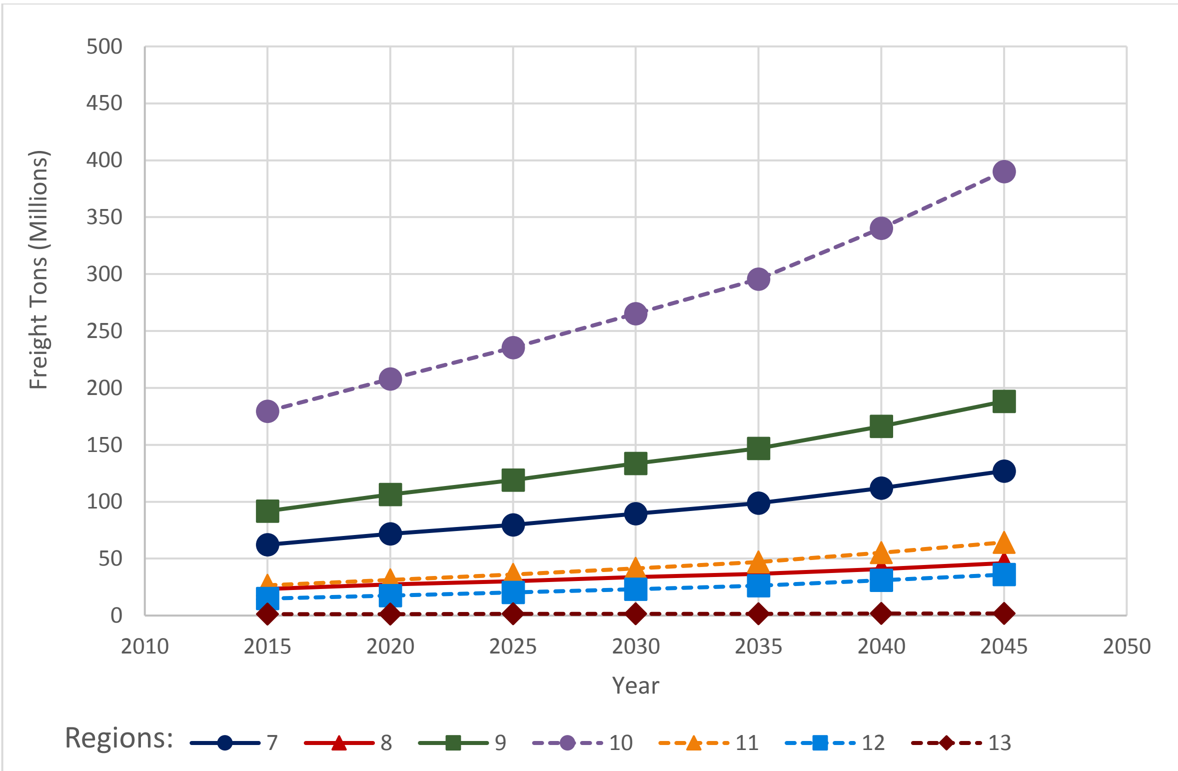


Figure 7-17 Annual Freight Crossings by Region 2015-2045 Millions of Markets

Source: Results from Scenario Planning of Future Freight and Passenger Traffic Flows across the US/Mexico and US/Canada Borders

Figure 7-18 shows a graph for daily passenger crossings for the Millions of Markets scenario. The trend is generally flat. A more localized move toward manufacturing improves the overall economic health of the region, thus inducing more border crossings, but the increase to manufacturing is not the consequence of large-scale global trade. Therefore, the growth is limited in nature.

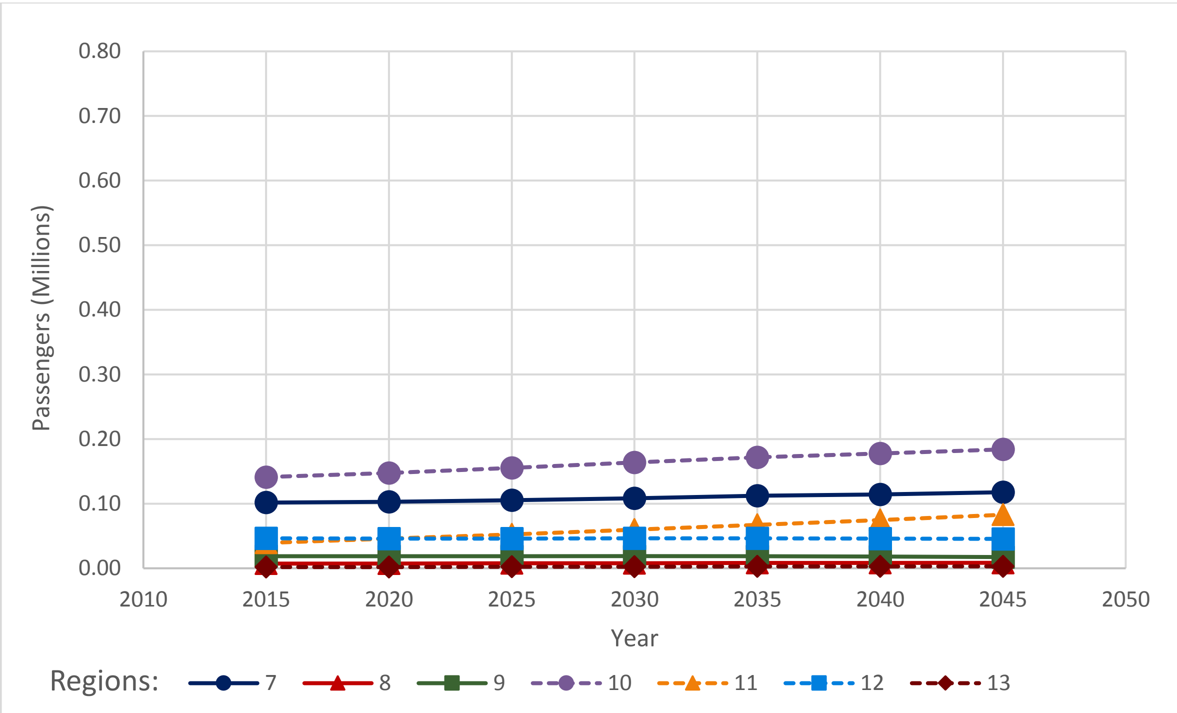


Figure 7-18 Daily Passenger Crossings by Region 2015-2045 Millions of Markets

Source: Results from Scenario Planning of Future Freight and Passenger Traffic Flows across the US/Mexico and US/Canada Borders

8. FUTURE RESEARCH

This section summarizes future research needed to enhance the current framework. As is the case with many studies involving analytical models or tools, early versions are based on certain assumptions that undergo refinements over time and form the basis of additional targeted studies.

8.1 NEEDS FOR FUTURE RESEARCH

There are many aspects of the current study that indicate the need for further research, including:

- First and foremost, this was the first known attempt of its kind to include all border crossings in a single study. There have been numerous studies of individual or multiple border crossings, which have included a lot more local detail. That level of detail was not warranted for a study at the national scale such as this. This study represents the first time that a border crossing study at a national scale attempted to look at all border crossings, down to the POE level, and to apply the scenario planning approach in this context. Additional research about how to best integrate the highly detailed local area and regional studies with this national approach is warranted. This study serves as a good first step, providing state, regional, and local agencies with consistent methodology for estimating future year border crossings.
- A second indication of the need for further study is that the *NCHRP 750,* the source of scenario analysis, was primarily focused on freight and did not have adequate information applicable to passengers. Due to the non-availability of passenger scenarios, it is possible that the freight scenarios used are ultimately not the best choices. This issue points to the need for a passenger counterpart of the *NCHRP 750* report.
- There is also an opportunity for future scenario planning studies to consider scenarios other than those described in *NCHRP 750*. These new scenarios can be designed to more specifically address impacts to border crossing behavior, rather than the more general *NCHRP 750* scenarios.
- The BTS Border Crossing/Entry Data used for this study notably did not include separate information on crossings by bicycle. Though crossings by bicycle are a known phenomenon along the border, and border communities do undertake Bicycle/Pedestrian planning studies to address this phenomenon, this study was only able to address bicycle crossings in a general sense.
- Finally, rapid technological advancements need to be studied for their applicability to such a large scale study.

8.2 EMERGING DATA SOURCES

In terms of data, there are several technology-oriented data types that would help to enhance the quality of the framework. The data sets mentioned herein are all proprietary sets of data that were not purchased for this study. While these datasets hold great promise, they currently possess significant limitations that made their use undesirable for this study. The most important limitation is that these datasets are not currently able to accurately track and report trips crossing national borders. These data-sets include, but are not limited to:

- AirSage Data: These data are collected by logging cellular phone location data from active cellular devices, provifing information on origin-destination movements, trip purposes, and “market areas” by border regions or specific crossings. The exact scope of data, however, needs to first be studied and then implemented.

- Inrix Data: These data are collected via GPS-enabled devices that log time-stamped location information from moving vehicles. This can provide operational insight into border crossings that may not be part of Highway Performance Monitoring System. There is a need to first perform a review of locations using the information from this study to develop a framework for such data acquisition.

- Metropia Data: Metropia data is another rich dataset that can be used to develop a crossing choice model. These data are collected via a smart device app as users program and follow time-saving routes for their journey. Several jurisdictions have or are in the process of implementing this data in their traffic monitoring process. The most significant initiative from a border crossing perspective is that of the City of El Paso, which could provide a template for other areas near the border. As of the time of writing this report, this data is limited to the US only.

There is also a need for coherent, internally consistent traffic count data at all locations, using all available sources. The BTS and TBWG data provide comparable border crossing statistics on the US-Canada border; a similar dataset on the US-Mexico border to capture outgoing traffic would be extremely beneficial.

8.3 TOOL REQUIREMENTS

It is not practical to identify specific tool requirements at this stage. However, one of the technologies that may be applicable to a massive data issue is “big data.” Big data is a term that has been coined to describe datasets that contain vast volumes of data collected very rapidly with a high degree of frequency. These data are often collected passively, with little to no burden of effort to the individual providing the data. An example of big data is the location tracking information generated, stored, and transmitted by an active cellular phone. These data can be post-processed and analyzed to provide insights into regional travel patterns by simultaneously considering the activities of millions of users.

Studies are needed to identify the exact nature of the applicability of such technologies, but the data sets discussed above in Section 8.2 are specific examples of big data that may have application to border crossing studies in the near future.

Another approach might involve the development of online survey portals to be completed by occupants crossing the border. This low-cost approach may provide substantial amounts of additional information.

8.4 SURVEYS AND STUDIES

In terms of surveys and studies, there are many traditional surveys that could provide consistent data for all locations. Many of the larger metropolitan areas support periodic border crossing surveys to gain a better understanding of cross-border travel behavior; however, only those areas with the most sophisticated modeling practices, such as Southern California, conduct surveys designed to provide insight on cross-border travel that are robust enough to be integrated into the travel demand model process. Most surveys are conducted for a purely planning context and not as a means of developing quantitative forecasting tools.

The level of effort required to conduct the more rigorous surveys required for border crossing forecasting model development and POE selection choice models might be cost prohibitive to local and regional agencies, who may not see a pressing need for this higher level of rigorous analysis. It would be beneficial to provide support to these regions and agencies for future facilitation of these types of surveys, as such information would dramatically enhance the next iteration of this current study. Some such surveys include:

- Stated Preference Surveys at border crossings or online.
- Traditional Intercept Surveys and hand survey card for Origin-Destination (O-D) studies.

Any additional support should be contingent on surveys conducted in a way that would provide the necessary information for the development of crossing forecasting and POE selection choice models.

9. CONCLUSIONS

This study represents one of the most comprehensive looks at overland border crossings between Canada, Mexico, and the United States to date. The scenario planning approach used in this effort proved very instructive in understanding the underlying dynamics influencing border crossing behavior along both borders. This approach revealed the ways in which each region along the border was more or less responsive to changes in certain factors, thus revealing a number of unique characteristics, such as the strong correlation between manufacturing employment and border crossings in the Michigan/Ontario area, or the strong relationship between employment in Mexico and crossing activities – all knowledge that will assist USDOT planning partners to better prepare for the future. Had a traditional point forecasting approach been followed instead, many of these findings may not have been discovered.

The conclusions discussed in this section are meant to assess the following study objectives:

- A framework of North American multi-modal transportation flows that builds upon existing and ongoing research in the United States, Canada, and Mexico.
- A common understanding and consensus between and within Canadian, Mexican, and United States agencies regarding a range of future scenarios that will impact freight and passenger traffic flows across the United States-Mexico and United States-Canada Borders through the year 2045 by using scenario planning methodology.
- Common sets of projections of binational population, business, and traffic data for each agency's planning efforts that are well documented and accessible to all agencies.
- Detailed micro-level population, business, passenger, and freight flow projections along and within the border regions of the United States and at each crossing.
- National macro-level regional multi-modal freight and passenger traffic flow, population, and industry projections between each country.
- A visualization system to display the proposed scenarios in a manner compatible with the Office of Planning, Environment, and Realty GIS Planning Tool (HEPGIS).

In addition to this report, this study has yielded a number of additional products that will be of great interest not only to border planning communities, but to transportation planners in all fields seeking to engage in a scenario planning approach. These products are discussed below:

- There are now four new FAF4 based freight flow databases. These are reflective of each of the four scenarios examined in this study. Additionally, these tables have state and province level disaggregation within Mexico and Canada, which will be of immeasurable value to the freight planning community.
- As the first study of this magnitude and kind, there are now a set of demand forecasting models for passenger border crossings. These regression models represent a significant advancement in border crossing demand modeling for many of the regions along the border, which are now able to conduct forecasts for their POEs with greater consideration for the

nuances driving these crossings. These models also represent a significant first step to future advancements in border crossing modeling.

- The amount of data generated by this study is too great to be adequately documented in a single report. A series of databases and spreadsheet models have been developed, culminating in the study's visualization system. This system and its attendant databases and spreadsheets will allow users of this study greater access to additional details not provided within this report.
- Finally, this study increased the profile of scenario-based planning approaches not just within the US, but also in Canada and Mexico. During the course of this study, it became clear that the ideas surrounding scenario-based planning are still relatively new to the planning community and many of its basic premises were misunderstood. The most significant difference between scenario planning and traditional forecasting is that traditional forecasting attempts to predict the future based on extrapolating existing trends, whereas scenario-based planning asserts the future and works backward from there. The differences can be subtle, but are significant. As scenario-based approaches continue to increase in popularity, the increased awareness of the methods provided by this study will facilitate the scenario planning process throughout all three countries.

9.1 FREIGHT CROSSING

The dynamics of border crossing behavior are distinct between passenger travel and freight travel. Freight travel border crossing tends to be a longer distance, with origins and destinations distributed throughout each of the countries as market-driven supply chain networks dictate. These movements are pinned more directly to national and international economic trends and tend to be less sensitive to regionally specific characteristics. The assessment of each scenario showed that changes to freight activity tended to be consistent between the regions, without much evidence of certain regions being disproportionally impacted.

Freight crossings for all scenarios and all regions are expected to increase over time; what differs is the rate at which they increase. Scenarios such as Naftastique show rapid front loaded growth, while the Global Marketplace scenario results in nearly the same amount of increase freight crossings by 2045, but occurs at a slower rate. In a Naftastique future, there is a greater sense of urgency in addressing the needs of increased demand, while there is more time available to respond to the trends in Global Marketplace. The One World order scenario shows the least amount of growth.

Figure 9-1 shows annual freight crossings along the US-Mexico border by scenario: Naftastique (NFTQ), Global Marketplace (GMKT), One World Order (OWO), and Millions of Markets (MOM). The FAF4 baseline is also provided for comparison. **Figure 9-2** shows the same graph for the US-Canada border.

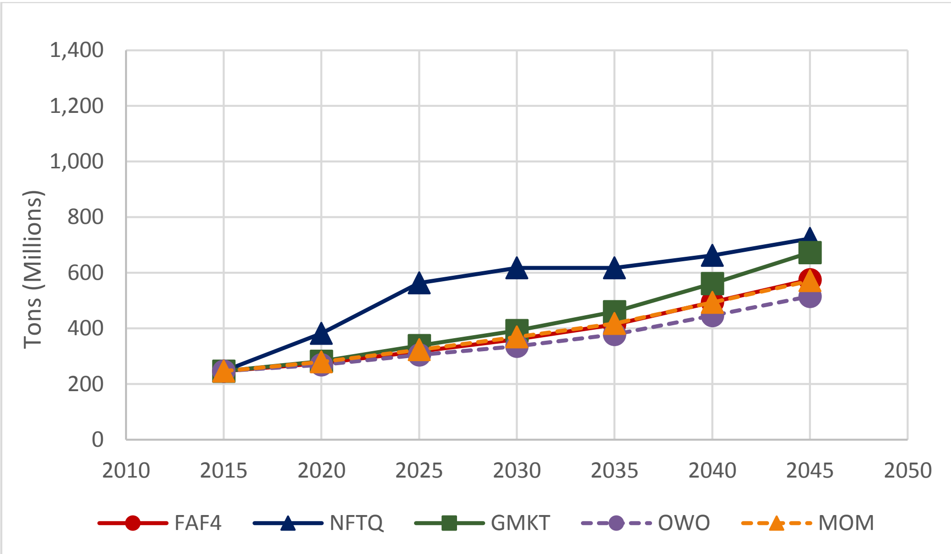


Figure 9-1 Annual Freight Crossings along the US-Mexico Border

Source: Results from Scenario Planning of Future Freight and Passenger Traffic Flows across the US/Mexico and US/Canada Borders

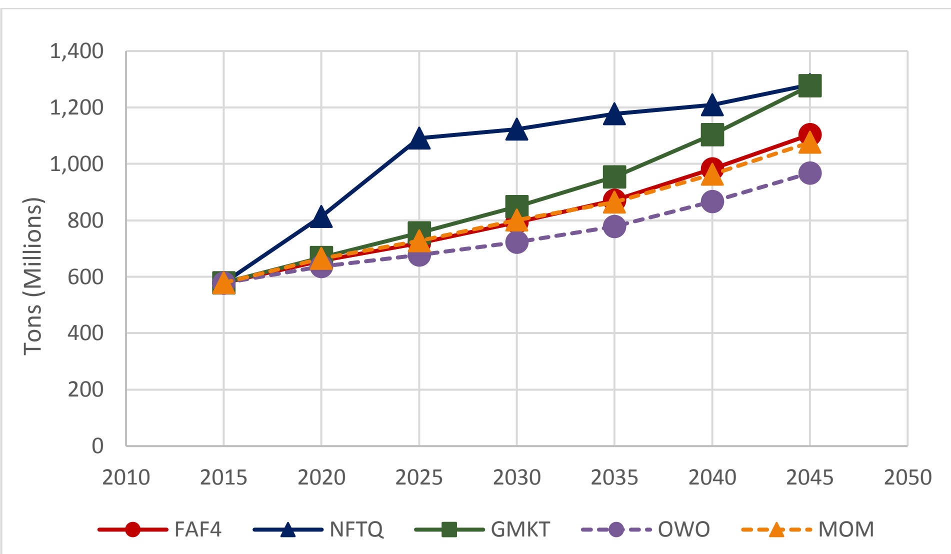


Figure 9-2 Annual Freight Crossings along the US-Canada Border

Source: Results from Scenario Planning of Future Freight and Passenger Traffic Flows across the US/Mexico and US/Canada Borders

9.2 PASSENGER CROSSING

Passenger crossings are a different matter. Unlike freight travel, passenger travel is highly influenced by local and regional characteristics; this is due primarily to the shorter distances traveled by passengers crossing land ports. In recent border crossing research, there is general agreement that passenger crossings are overwhelmingly short distance and truly local in nature. For example, the 2007 Imperial County Cross-Border Study found that approximately 96% of all passenger vehicles crossing into the US at the Mexicali/Calexico point of entry originated in Mexicali and were destined to locales within California, primarily within the Imperial Valley, with 65% remaining in Calexico. Similarly, the 2013/ IMTC Passenger Vehicle Survey Report of Interim Findings showed that approximately 75% of individuals entering the US at Peace Arch were residents of the Western Lower Mainland, which includes Vancouver, B.C., and that they predominantly (58%) traveled to Whatcom County, WA at the border, with another 14% traveling to the Puget Sound region. The 2004 Canada-United States-Ontario-Michigan Border Transportation Partnership Planning/Need and Feasibility Study Existing and Future Travel Demand Working Paper likewise showed that 79% of all passengers crossing the US-Canada border at the Ambassador Bridge or Detroit-Windsor Tunnel were making local trips between Essex and Kent County in Ontario and the Southeast Michigan Council of Governments region.

The US-Mexico border is highly responsive to the economic factors driving crossings. Expected crossings range from unprecedented highs that could strain existing infrastructure and manpower to historic lows that are well within existing capabilities to manage. In particular, the strength of long-term economic growth in Regions 1, 4, and 6 should be monitored closely. The stronger the growth of the economy in these regions, the more likely it is that border crossing demand will exceed past expectations. As crossings increase, the number of bicyclists and pedestrians crossing the border will also increase, creating new concerns regarding bicycle amenities, pedestrian safety, and access to public transport. **Figure 9-3** shows daily passenger crossings along the US-Mexico border by scenario. The prevailing trends (PT) are included as a point of reference.

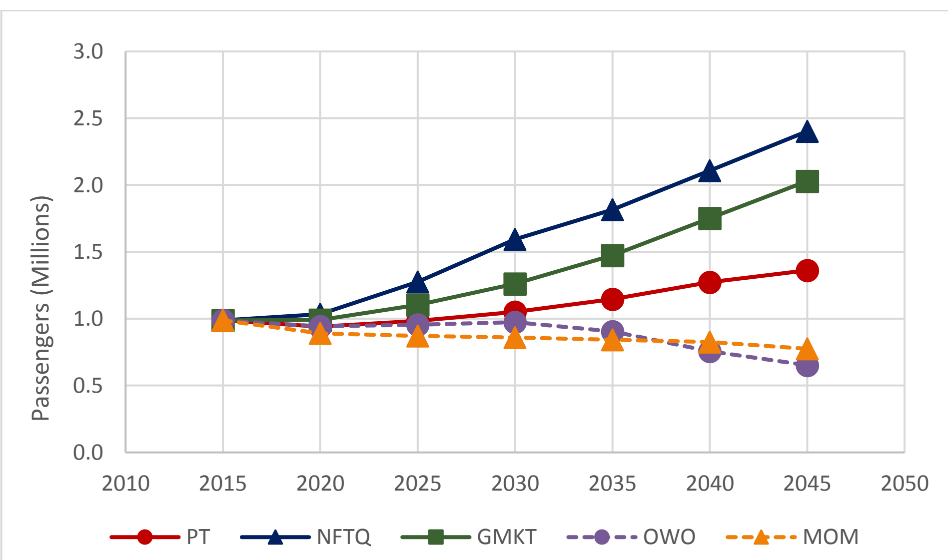


Figure 9-3 Daily Passenger Crossings along the US-Mexico Border

Source: Results from Scenario Planning of Future Freight and Passenger Traffic Flows across the US/Mexico and US/Canada Borders

The US-Canada border is less reactive with respect to passenger crossings, as long-standing socioeconomic pressures have reduced the number of border crossings. Region 10 is unlikely to regain the high levels of border crossings achieved in 1996 by this study's 2045 horizon. To the extent that it is possible, it would be dependent upon a resurgence of the region's economy through either a renaissance in manufacturing or a complete revolution in the region's economy, such that some other sector replaces and surpasses the area's long-standing reliance on manufacturing. Region 11 is poised to see consistent long-term growth in border crossings, assuming that Canada's pattern of population migration to communities along the US border continues. Region 13, though a much smaller share of all border crossings, is likewise set to experience significant growth relative to its current levels of border crossings, nearly doubling in each scenario. Region 7 may rise or fall, primarily depending on how much employment grows in Canada.

An interesting feature of the Canadian border is that in Regions 7, 11, and 12, border crossings are negatively correlated to Canadian employment. Presumably, employment rate increases on the Canadian side of the border better satisfy the economic needs of Canadian residents, making them less likely to seek goods and services in the US. **Figure 9-4** shows the daily passenger crossings for the US-Canada border. Though difficult to see, the results for Naftastique and Global Marketplace are very similar. The results from Millions of Markets and the prevailing trends are also very close.

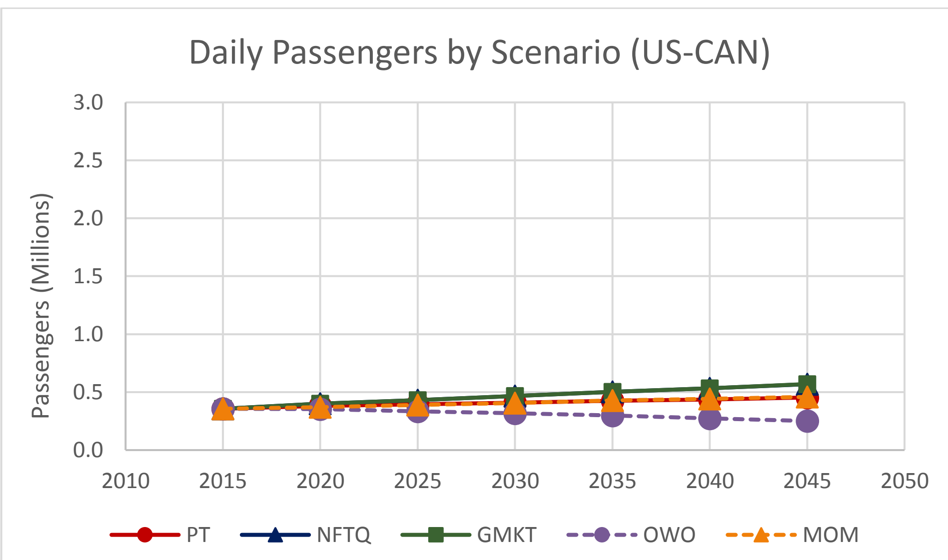


Figure 9-4 Daily Passenger Crossings along the US-Canada Border

Source: Results from Scenario Planning of Future Freight and Passenger Traffic Flows across the US/Mexico and US/Canada Borders

9.3 IMPLICATIONS

Each region proved to be a unique area with respect to border crossing behavior, and more research should be conducted at the regional levels to better understand these dynamics. Many of the regions are well populated and contain MPOs on the US side that are tasked with planning for long-term transportation needs, using transportation models to forecast travel demand. Often, these models treat the border ports as external stations, with trips crossing the border determined by a simple process of linear extrapolation or a traffic growth rate based directly on population growth.

Some areas, such as Southern California, have been investing in better ways of modeling their cross-border demand. Others, such as the City of El Paso, are trying to first improve their data environment. Through a multi-agency partnership in El Paso with a mobile app vendor, the city is preparing to extend the app’s service to Ciudad Juarez. The app currently allows users to optimize their travel routes, taking time and historical traffic patterns into account. Though the city hopes to use the app to redirect travelers to under-utilized border crossings, the app also collects origin and destination data. A better understanding of origins and destinations acquired by leveraging these emerging big data technologies will go a long way in filling in border crossing behavior knowledge gaps.

The issue of border crossings will continue to be addressed in inter-agency processes between local, regional, state, national, and international partners. As these partners discuss ways to best meet the demands of an uncertain future, the scenario planning approaches utilized in this study can serve as a guide for local and regional planning efforts along the border. This report, along with the visualization tool developed with the data products of this study, offers assistance to regional and statewide planners in the development of scenario-based assumptions of future year border crossings, which they can use to better understand – and plan for – the different impacts of these scenarios on local transportation infrastructure.

APPENDICES

Appendix – A: A Review of *NCHRP 750*

Appendix – B: Inventory of Border Master Plans

Appendix – C: Border Area Transportation Models

Appendix – D: Tables of Data Sources

Appendix – E: Spring Workshops, 2015

Appendix – F: Spring 2015 Webinar

Appendix – G: June 2016 Workshops

Appendix – H: Regression Analysis Outputs

A. A REVIEW OF NCHRP 750

A.1 BACKGROUND

An extensive review of the approach and concepts introduced in the study *National Cooperative Highway Research Program Report 750 Series: Strategic Issues Facing Transportation (NCHRP 750)* was undertaken as part of the current study. These concepts form the basis of the analysis conducted along these lines and are documented throughout the report *Scenario Planning of Future Freight and Passenger Traffic Flows across the US/Mexico and US/Canada Borders*. Appendix A provides a summary of the review, pointing to important concepts and applicability of the NCHRP research on the current study.

NCHRP 750 had two major objectives. Firstly, it provided decision makers (at all levels and across all stakeholders) with a critical and comprehensive analysis of the factors, trends, and uncertainties that may affect the U.S. freight transportation system over the next 30 to 50 years.

Secondly, and most importantly, it introduced the Scenario Planning Methodology to these decision makers (primarily at the state department of transportation [DOT] level) for their use in creating a more flexible, adaptive, and responsive transportation management strategy on an ongoing basis. An alternative to the traditional planning method, scenario planning creates future scenarios based on global trends. By considering these alternate scenarios, transportation leaders and freight stakeholders are able to evaluate and plan for likely futures. Unlike the traditional quantitative methods, this process encourages an open dialog that results in more informed decision-making. It allows stakeholders to discuss trade-offs, nuances, and cause-and-effect relationships that would not be identified in the traditional planning process. By working through the alternate futures described in each scenario, stakeholders were able to extract the common needs likely to be relevant no matter what the future may hold.

Essentially, it provides another tool for transportation decision-makers. As a side benefit, this methodology will engender more productive interaction between the diverse stakeholders of the U.S. freight, as well as passenger, transportation system.

It is important to point out that the NCHRP project was not to develop the official version of the future for the U.S. freight transportation system to be used by all of the decision makers. The system is too large and complex and faces too many uncertainties for this to be possible. Therefore, the project did not simply provide a static list of actions that a DOT might undertake to prepare for the future. Instead, it provided a set of customized scenario planning tools and procedures that can be adopted and immediately implemented by the various decision makers across the stakeholders.

A.2 STUDY FORMAT

NCHRP 750 describes the methodology used to develop the scenarios. Traditional methods are presented along with examples from different organizations, which are then compared and contrasted with the methodology used for the development of the Future Freight Flows (FFF) scenarios created as part of this project. The Report also provides an overview of the scenarios themselves. Each of the four scenarios was described and compared. The Report also details how these scenarios were used in the six Scenario Planning Workshops held across the United States in 2010 and 2011. Finally, the Report provides summaries of the workshop results; suggestions on how the scenario planning process can be incorporated into existing freight infrastructure processes within a State DOT; and recommendations for future research.

A.3 THE REAL VALUE OF SCENARIO PLANNING

Scenario planning is a process of long-term strategic planning that involves the development and use of future scenarios of the problem or system at hand. A scenario is a vision of a possible future state of the world and the relevant environment. Simply put, scenario planning helps decision makers and planners to shift from forecasting the future – a challenge in itself as predicting future social, economic, demographic, political, environmental, regulatory, and technological trends, to name a few, is difficult at best – to preparing for potential effects of the scenarios.

Scenarios are methodically constructed stories about alternative futures in which today's decisions might play out. A good scenario must be plausible, internally consistent, and challenging for strategic purposes. It should compel the decision makers to see the future in new ways and question their unspoken assumptions. A scenario planning engagement should involve the use of multiple, mutually exclusive scenarios.

Traditional planning and forecasting procedures are rooted in present day assumptions based on recent experience. These planning practices assume a continuation of recent trends into the future. As a result, the traditional planning process is poorly suited to contending with unanticipated deviations from these trends. When deviations occur, planners find that their previous analyses become less useful for preparing for the future and more effort is expended to understand the impacts of these new developments. It is these deviations which can undermine the effectiveness of long-range planning.

The value of the scenario planning process is that it allows planners to consider alternative events that do not follow from established trends. These alternative events, treated as scenarios, can lead to widely different assumptions of future impacts, which prepares the planner with awareness. Assuming that the scenarios considered are sufficiently diverse, there is a greater likelihood that actual future events align with one of the scenarios. In this way, the planner is never truly unprepared.

B. INVENTORY OF BORDER MASTER PLANS

The US-Mexico Joint Working Committee on Transportation Planning (JWC) has conducted many studies along the US-Mexico border. Most of the following information is taken from the JWC website (https://www.borderplanning.fhwa.dot.gov/masterplans.asp):

B.1 REGIONAL BORDER MASTER PLANS

- Arizona – Sonora Border Master Plan (February 2013)
  - This border master plan presents a comprehensive binational approach to coordinating the planning and delivery of projects to improve traffic operations at each of nine land ports of entry (LPOEs) along the Arizona-Sonora border and to enhance the efficiency of the multimodal transportation infrastructure providing access to the LPOEs.

- California – Baja California Border Master Plan (2014 & 2008)
  - The California-Baja California border master plan is a binational comprehensive approach to coordinate the planning and delivery of projects at LPOEs and transportation infrastructure serving those POEs in the California-Baja California region. The California Department of Transportation, in partnership with the Secretariat of Infrastructure and Urban Development of Baja California (Secretaría de Infraestructura y Desarrollo Urbano del Estado de Baja California [SIDUE]) and the US-Mexico Joint Working Committee, retained the San Diego Association of Governments Service Bureau to assist in the development of this plan.

- New Mexico – Chihuahua Border Master Plan (December 2015)
  - The purpose of the New Mexico-Chihuahua border master plan is to develop an integrated transportation infrastructure plan to guide future improvements and to enhance the efficiency and effectiveness of cross-border transportation facilities encompassed by its three principal metropolitan areas: the southern portion of Las Cruces, New Mexico; Deming, New Mexico; and Juárez, Chihuahua.

- El Paso-West Texas Region – Chihuahua Border Master Plan (October 2013)
  - This border master plan represents a comprehensive, binational, long-range effort to improve the border transportation system in the El Paso/Santa Teresa-Chihuahua Region.

- Lower Rio Grande Valley – Tamaulipas Border Master Plan (October 2013)
  - The purpose of this comprehensive, binational, long-range plan is to improve the border transportation system in the Lower Rio Grande Valley-Tamaulipas Region.

- Laredo-Upper Rio Grande Area – Coahuila, Nuevo Leon & Tamaulipas Border Master Plan (June 2012)
  - This border master plan documents the needs and priorities of the Laredo-Coahuila/Nuevo León/Tamaulipas region. It also recommends a mechanism to ensure coordination on current and planned future projects, and supporting transportation infrastructure to serve the anticipated demand imposed by a growing population and an increase in economic activity in the study area.

B.2 STUDIES OF BORDER WAIT TIMES AND CROSSING TIMES FOR COMMERCIAL VEHICLES

Crossing and wait times for commercial motor vehicles are key indicators of transportation, LPOEs, and international supply-chain performance. In an effort to establish a baseline and ongoing measurements of border crossing and wait times, border wait time technologies are being deployed to measure travel times for commercial trucks crossing from Mexico into the United States.

The Border Crossing Information System (BCIS) is a product of this effort. It provides information on real-time border wait times and crossing times, as well as historic data. The following border crossings locations are reported on the BCIS site (http://bcis.tamu.edu/Commercial/en-US/index.aspx):

- Laredo, TX (World Trade & Colombia-Solidarity POEs)
- El Paso, TX (Bridge of The Americas & Ysleta Bridge)
- Brownsville, TX (Veteran's Memorial Bridge)
- Eagle Pass, TX (Camino Real International Bridge)
- Pharr, TX (Pharr-Reynosa POE)
- Nogales, AZ (Nogales-Mariposa POE)

For the northern border, the United States Department of Transportation (USDOT) and Transport Canada formed the Canada-US Transportation Border Working Group (TBWG), which has resulted, among other things, in the Border Crossing Database (BCD). Although this database is no longer maintained and the most recent data date back to 2010, it provided extensive information about each border crossing via its searchable web portal.

In addition to the above initiatives, there have been many location-specific studies as part of different projects that contain results of traffic operations specific to the location. These include studies for Laredo, TX; El Paso, TX; Pharr, TX; and Otay Mesa, CA.

C. BORDER AREA TRANSPORTATION MODELS

C.1 US-MEXICO EXISTING TRANSPORTATION MODELS

The literature review task involved a review of existing transportation models. It should be kept in mind that additional new/updated models may have been developed after the time at which the literature review was conducted, and are not necessarily included in this document.

C.1.1 The Federal Highway Administration's Freight Analysis Framework

The Freight Analysis Framework (FAF), developed by the Federal Highway Administration (FHWA), is an ongoing model for the United States that provides a comprehensive national picture of freight movements among states, sub-states regions, major metro areas, and major international gateways by integrating data from a variety of sources, including:

- Commodity Flow Survey (CFS)
- County Business Patterns (CBP)
- Bureau of Economic Analysis (BEA)
- Bureau of Transportation Statistics (BTS)
- USDA Census of Agriculture
- PIERS Import/Export Database
- USACE Waterborne Commerce Database

The model is calibrated every three years after the development of the Commodity Flow Survey (CFS), and provides estimates for tonnage and value by commodity type, mode, origin, and destination. FAF4 includes annual freight tonnage and dollar value, broken down by transportation mode and commodity class, for the base year 2015 and forecast years 2020, 2025, 2030, 2035, 2040, and 2045. FAF4 reports annual tonnage and dollar-valued freight flows using the same 43 2-digit Standard Classification of Transported Goods (SGTC) classes used by the Commodity Flow Survey.

C.1.2 Border Wizard

The Border Wizard™ is a model developed by the Federal Highway Administration (FHWA), in conjunction with the General Services Administration, the U.S. Customs and Border Protection, and the U.S. Immigration and Customs Enforcement, to simulate Federal inspection activities, including customs, immigration, freight, and security procedures for auto, bus, truck and pedestrian travel through a POE in order to determine the infrastructure, facility, and operational needs at the POE. Although the Border Wizard™ can be used for the operational evaluation of a POE, it is not a travel demand model.

C.1.3 2009 California Statewide Travel Demand Model (CSTDM) [8]

The California Statewide Travel Demand Model (CSTDM), developed by California Department of Transportation (Caltrans), is an ongoing travel demand model for the State of California. The CSTDM includes an External Vehicle Trip Model (for trips with origin and/or destination outside California) to forecast passenger car and commercial vehicle trips made between 51 external zones (including an external zone for each international POE) and internal zones. The CSTDM uses a modeling methodology similar to the SANDAG Activity Based Model (ABM). The SANDAG ABM and the Caltrans model estimate future border crossing demand as a near linear extrapolation of existing trends. The SANDAG ABM uses this extrapolated crossing number as a control total. This is plugged into an allocation model that assigns crossings to specific POEs based on proximity to POE, wait times, and trip purpose.

C.1.4 Arizona Travel Demand Model (AZTDM)

The Arizona Travel Demand Model (AZTDM), developed by Arizona Department of Transportation (ADOT), is an ongoing four-step travel demand model for the State of Arizona. The model – in conjunction with local models and studies that allowed for a greater level of detail in travel forecasting parameters – was used to estimate the 2035 forecast travel demand database for the state. The cross-border traffic is accounted for by taking data from the Office of the Secretary of Transportation – Research (OST-R) Border Entry Data and looking at the total number of personal vehicles and loaded and empty trucks crossing into the US via each Arizona border crossing. This allows for the determination of distribution between autos and trucks.

C.1.5 San Diego Association of Governments (SANDAG) Transportation Model [9]

The SANDAG enhanced four-step transportation model, developed by the San Diego Association of Governments, is an ongoing model for the San Diego County. The model is calibrated every two to foyr years depending on the model component. For cross-border travel, the model generates trip ends for passenger vehicles and trucks separately. In the passenger model component, the imputed number of base-year passenger trip ends for each POE is calibrated to measured counts, and future year passenger trip ends are determined by a regression analysis of border crossings. This regression employs population as the independent variable, using the value as a predictor of border crossings and using these estimates and future population growth to measure future border crossings. In the truck model component, truck trip ends are determined based on freight movements provided by the Freight Analysis Framework (FAF), which are converted to truck trip ends by applying factors for payload and vacancy. These truck trip ends are then distributed and assigned to the transportation network along with all of the other regional trip ends.

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8 http://www.dot.ca.gov/hq/tpp/offices/omsp/statewide_modeling/files/Library/Old%20Info%20CSTDM09/tdm/CSTDM09_Final_Model_Documentation.zip

9 http://www.imperialctc.org/media/managed/pdf/1_California_Baja_California_2014_BMP_Update_FINAL_July2014_Web_Part6.pdf

C.1.6 SCAG Transportation Model [10]

The SCAG transportation model, developed by the Southern California Association of Governments, is an ongoing model for the counties of Los Angeles, Orange, San Bernardino, Riverside, Ventura and Imperial. At the time of this review, the model base year is 2008 and it is calibrated every 2 to 4 years depending on the model component. The horizon year is 2035. This model is an advanced four-step transportation model. For cross-border travel, the model provides trip distribution and growth rates for crossings at each POE.

C.1.7 SIDUE Matrix

The SIDUE Matrix, developed by the Secretariat of Infrastructure and Urban Development of Baja California (SIDUE) of Mexico, is an ongoing database for the State of Baja California that is being populated with information from several regional studies. The database provides a matrix of origin-destination pairs, 2030 traffic projections, and traffic patterns with regional roadways connections. SIDUE also maintains datasets of population, housing, income, and land use estimates for the Baja California region.

C.1.8 SCT Model

The SCT Model, under development by the Secretariat of Communications and Transportation (SCT), is a commodity flow model for Mexico. This model considers three levels of analysis: the macro level (nationwide), the meso level (state and regions) and the micro level (metropolitan areas). This model will provide commodity flows by geographic areas, baseline commodity transportation costs, baseline origin/destination travel times, and baseline and forecasted economic data for the horizon year 2030.

C.1.9 SCT SimFronteras

The SimFronteras, developed by the Secretariat of Communications and Transportation (SCT), is a simulation model to analyze queuing, processing and inspection time scenarios for the POEs. This simulation model, rather than just being a Spanish language version of BorderWizard™, incorporates significant user interface and modeling flexibility improvements to assist both the public and the private sectors in balancing the demands of binational trade with those of customs and immigration enforcement.

C.1.10 Tijuana Metropolitan Area Models

Tijuana Metropolitan Area Models are study specific models developed by the Metropolitan Institute of Planning (IMPlan) and the SCT; therefore, they have not been updated on a regular basis. These models include:

- The SCT Tijuana Metropolitan Transportation model, developed in 2005, is a four-step model that focuses on transit planning in the Tijuana area.

[10] ibid

- The SCT Felipe Ochoa Otay East Travel Demand Model, developed in 2007, is a travel demand model on the conceptual master plan for the Otay Mesa East POE. This model also has simulation capabilities.

- The SCT C&M Tijuana-Tecate Toll Road Model, developed in 2009, is a travel demand model that optimized traffic and revenue of Mexican Federal Highway 2 Toll Road.

The Municipal Institute of Planning of Mexicali (Mexicali IMIP) is an institution of Mexicali responsible for urban planning activities. The IMIP does not have a travel model; however, maintains databases of population, housing, and land use estimates for its metro region.

C.1.11 The San Diego-Baja California Joint Cross Border Model

The San Diego-Baja California Cross Border Model, developed jointly by SANDAG, Caltrans District 11, and IMPlan Tijuana, is a study specific four-step travel demand model developed in 1995. The base and horizon years of the model are 1995 and 2020, respectively. The geographic coverage of the model includes the San Diego County and portions of the municipalities of Tijuana, Tecate, Playas de Rosarito, and Ensenada. The model provides trip tables and traffic volumes on the roadway and transit networks. The roadway component of this model was updated in 2006, but no other components were updated – nor were the models recalibrated – to a new base year.

C.1.12 Texas Statewide Model

The Texas Statewide Analysis Model version 3 (SAMv3) is a traditional 4-step model with passenger and freight components for model years 2010, 2020, 2030, and 2040. There are 4,535 internal zones and 122 external station zones. The network consists of a master network of roadway, rail, air, and waterway routes.

The model provides forecasts for passenger travel (highway/auto, rail, and air) and freight transport (highway/truck, rail, air, and water). The freight model is based on tonnage by 15 commodity types, which are aggregations of the 2-digit Standard Transportation Commodity Code (STCC) commodity types from the TRANSEARCH® database purchased by TxDOT.

The Texas statewide model is a traditional trip-based model with emphasis on forecasting demand by passenger and freight vehicles. The international highway crossings forecasts are conducted using the Texas SAMv3 assigned volumes for the Texas Primary Freight Network, adjusting these volumes based on observed traffic counts, and forecasting the adjusted base year volumes to 2040 using growth rates developed from historical traffic counts, SAMv3 assignment growth rates, or TRANSEARCH® flow growth rates. The international rail crossings forecasts are conducted using the Texas SAMv3 assigned volumes for the Texas Primary Freight Network and forecasting the adjusted base year volumes to 2040 using growth rates developed from SAMv3, TX-NAFF, and TRANSEARCH® flow growth rates.

C.2 US-CANADA EXISTING TRANSPORTATION MODELS

Canada-US border models vary significantly in sophistication. Some states or provinces have a comprehensive understanding of border crossing preferences and commodity flows, and are able to simulate future transportation demand based on economic projections. Others treat border crossings as external zones that are forecasted to increase at historic rates, and either assume constant origins/destination pairs or do not have data on the origin/destination of passenger and freight border flows. The most robust examples of models appear to coincide with strong binational connections between the US and Canada and/or where large investments are being made, such as the Detroit River International Crossing.

C.2.1 Whatcom Regional Travel Demand Model [11]

The Whatcom Regional Travel Demand Model is a four-step travel demand model that has undergone periodic updates from its original creation in 2000. The model was updated in 2008 and again in 2010, and it covers Whatcom, Skagit, and Island Counties (Northwest Washington). The base year of the current model is 2010 and it currently forecasts data through 2032; it will be updated spring 2015 to forecast out to 2036. The model consists of 961 internal and eight external traffic zones. Border crossings are incorporated into the model using the crossing counts for truck and passenger vehicles and are treated as external zones using historical data to forecast future flows. From a seed-through-trip matrix (available from the previous version of the Whatcom model), a growth factor (or a FRATAR) process was used to generate future flows.

C.2.2 Bi-National Truck Border Choice Model (Whatcom) [12]

The Bi-National Truck Border Choice Model was developed in 2004 for binational and regional planning applications. The model was developed by Halcrow Consulting Inc for the Whatcom Council of Governments and the Border Policy Research Institute as part of the International Mobility and Trade Corridor Program (IMTC). The Bi-national Truck Border Choice Model evaluates commercial vehicle travel through the Pacific Highway, Lynden/Aldergrove, and Sumas/Huntingdon ports-of-entry (Northeast Washington). The model predicts border crossing locations for commercial vehicles in the region using a multinomial logit model that uses trade flow, congested travel time, and border wait times along with cross-border bias (which reflects the influence of other factors that are not explicitly defined by the model). However, it does not forecast future truck traffic. The model was created in 2004 and underwent a recent assessment in 2009 to determine if the projections match the 2009 Commercial Vehicle Operations Survey.

C.2.3 Bi-National Commercial Vehicle Transportation Model (Transport Canada)

The Bi-National Commercial Vehicle Transportation Model was developed for Transport Canada. This model encompasses four regions: Metro Vancouver, Whatcom County, Skagit County, and Puget Sound/Greater Seattle. The model is comprised of 182 traffic zones that cover both the US and Canadian side of the border. The model uses an econometric model based on commodity, economic factors, and the direction of the freight flow. The model also accounts for empty trucks and the various total truck payload factors for each commodity type, allocating truck traffic to a specific border crossing based on a commercial vehicle operations survey. Using both commodity flow and border choice data to determine travel demand on roadways internal to the model, it is a good example of the

[11] http://wcog.org/wp-content/uploads/documents/model_whatcomcounty-report.pdf
[12] http://theimtc.com/wp-content/uploads/documents/BorderChoiceModelAssessment.pdf

incorporation of data collection efforts into transportation demand modeling of border crossings and border infrastructure.

C.2.4 Cascade Gateway Travel Demand Model (Whatcom) [13]

The Cascade Gateway Travel Demand Model was developed for the Whatcom Council of Governments. The four-step model (with a base year of 2000) covers the Greater Vancouver, Whatcom County, Skagit County, and Puget Sound. The difference between this model and the Whatcom model is that while the latter focuses on travel in Whatcom County, this model takes travel between Vancouver and Seattle, via Whatcom County, into consideration.

The model is separated into 174 traffic analysis zones using four ports of entry: the Peach Arch, Pacific Highway, Lynden/Aldergrove, and Sumas/Abbotsford. Passenger trips are based off an origin destination survey of trip types, such as work, recreation, shopping, vacation, and external trips. The model consists of three periods – a.m. peak, p.m. peak and off peak – for summer, fall, weekends, and weekdays. The passenger travel demand model allows each trip to choose a border crossing based on a border choice model. The border crossing choice model is a function of border crossing bias, congested travel time, and border wait time.

C.2.5 SEMCOG's Travel Demand Model [14]

SEMCOG maintains a travel demand model for the counties of Livingston, Macomb, Monroe, Oakland, St. Clair, Washtenaw, and Wayne that was created by Cambridge Systematics Inc. The SEMCOG model has been in existence since 2001 and was updated in 2012. The model has the ability to forecast out to 2040. It is comprised of 2,899 zones, with 88 of those zones being external; it treats the border crossings as external zones based on the last external station survey conducted by SEMCOG in the mid-1990s.

C.2.6 Detroit River International Travel Demand Model (MDOT) [15]

The Detroit River International Crossing (DRIC) Model was developed for the Michigan Department of Transportation. The model covers SEMCOG and Windsor/Essex County roadway networks. The model uses a multi-modal and multi-class user equilibrium model assignment to load forecasted vehicle flows onto the network. Additionally, the model allows for traffic to be segmented based on commercial vehicles, cars, and international traffic. The model uses a logit method to allocate traffic to specific border crossings either at the Port of Huron/Sarnia or the three Detroit River crossings. This allocation is based on the overall and border crossing specific travel times and costs between zones in the US and Canada. This model allows for alternative assessments of border infrastructure by integrating both the logit model and assessing roadway congestion.

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[13] http://wcog.org/wp-content/uploads/documents/model_cascadegateway-report.pdf

[14] http://semcog.org/Plans-for-the-Region/Transportation/Travel-Forecast#882179-additional-materials

[15] http://www.partnershipborderstudy.com/pdf/Travel%20Demand%20Model%20Update.pdf

C.2.7 Ontario Ministry of Transportation Truck Model

The Ontario Ministry of Transportation Truck model, initially created by IBI group, has undergone a series of internal updates. The truck model forecasts travel demand for provincial roadways using a base year and forecasting year, using bi-directional facility counts at border crossings from the operators of the border crossings as an external zone. The model uses an IHS projection for future commodities and National Roadside Survey and Commercial vehicle survey truck origin destination data to estimate and allocate truck traffic from border crossings.

C.2.8 Buffalo-Niagara

Buffalo-Niagara uses the Greater Golden Horseshoe (GGH) and the Strategic Demand Forecasting Models (SDFM) for estimating passenger and commercial vehicle demand. The GGH model is a four-step model developed for the Ontario Ministry of Transportation that has more than 3,000 zones and forecasts passenger travel. According to consultations, the GGH uses a relatively simple approach to the border crossings. The SDFM uses historical data and current trends to inform the anticipated travel demand.

C.2.9 Pembina-Emerson Port of Entry Model (Manitoba Infrastructure and Transportation)

The Pembina-Emerson Port of Entry model was developed by Manitoba Infrastructure and Transportation. The model specifically focuses on the Pembina-Emerson port of entry and displays the importance of modeling discrete events when modeling border operations. The model extends out to 2035 using IHS National Commodity and Trade Flow Survey for commercial vehicles and historic passenger data to estimate future growth, and simulates investment scenarios based on hourly arrival rates.

C.3 MODEL LESSONS LEARNED

There are a number of travel demand models developed for both the US-Canada and US-Mexico border. The models in areas with larger urban populations tend to be larger and more complex; this is the case for places such as Southern California and Detroit, MI. A common theme among all of the models is that changes to border crossing demand over time follows a rather straightforward process of extrapolating existing trends. This process entails extrapolating from past border crossing trends or changes to population over time. For models with traffic analysis zones on both sides of the border, future year crossings are determined by either using an extrapolated control total or applying a fixed demand origin-destination table to changes in population from existing border crossing origin-destination surveys. More work appears to be done allocating future crossings to specific crossing locations.

Logit choice models employed in regions such as Detroit, MI; Southern California; and Whatcom County, WA emphasize toll prices (where applicable), travel times, border wait times, and proximity to the POE. These models do not exist for every region, and where they do exist, they assume that the underlying demand is fixed. The number of border crossings is not in question; rather, it is the POE utilized for the crossings that is being modeled.

As with other choice models, the potential to transfer parameters to other regions that have not yet developed their own POE choice models is likely to be low. Preference should be given to models and parameters estimated from local revealed preference or stated preference surveys. The development of these models may be best left to local, regional, and state agencies who are in a good position to understand local travel patterns.

The greatest finding regarding this review of travel demand models along the border is that there is a general lack of nuanced understanding of what generates border crossing demand. Keying demand off of past trends in traffic or population growth appears to be a universal approach for border crossings and is aligned with standard traffic forecasting and modeling practices. Unfortunately, these techniques fail to capture many of the economic nuances that can impact border crossing demand.

An effort to understand the impacts of the variable economic factors in border crossing demand would fill a significant gap in the border modeling process, and would be instrumental in developing scenario based analyses. An improved border crossing demand generation method would also benefit regions with existing POE choice models by providing crossing demand control totals that would be sensitive to border crossing demand factors beyond population growth.

D. TABLES OF DATA SOURCES

Table D-1 North American Transportation Data Sources

Data Source	Sponsoring Organization	Modal Coverage									
		Truck	Rail	Maritime	Inland Waterway	Air	Intermodal	Pipeline	POVs	Buses	Pedestrians
North American Transportation Statistics (NATS):											
• Air Carriers (Form 41 Traffic) All Carriers	Bureau of Transportation Statistics (BTS)					F/P					
• Border Crossing Data (US-Mexico Border and U.S. Canada Border)	Bureau of Transportation Statistics (BTS)	F	F/P				F		P	P	P
• North American Transborder Surface Freight Data	Bureau of Transportation Statistics (BTS)	F	F	F				F			
• U.S. Waterborne Foreign Trade & US Foreign Container Trade: by US port and trading partner	U.S. Maritime Administration (MARAD)					F					
• Freight Analysis Framework (FAF)	• U.S. Department of Transportation	F	F	F		F	F				
• Freight Performance Measurement Program	• Federal Highway Administration (FHWA)	F									
• U.S. Customs and Border Protection Border Wait Times	• U.S. Customs and Border Protection	F						P			P
• Passenger Intercept Survey	• International Mobility and Trade Corridor Program								P		
• Cascade Gateway Border Data Warehouse	• Whatcom Council of Governments	F							P	P	
• Commercial Vehicle Operations Border Evaluation Study	• Whatcom Council of Governments	F							P	P	
• Commercial Vehicle Survey	• Ontario Ministry of Transportation	F									
• National Roadside Survey	• Canadian Provinces	F									
• 2007 Niagara Border Crossing Origin-Destination survey	• Ontario Ministry of Transportation								P		
• Public Border Operators Association Traffic Data	• Public Border Operators Association	F							P	P	
• Trucking Commodity Origin-Destination Survey, Canada-USA	• Statistics Canada	F									
• Rail Commodity Origin and Destination Survey	• Statistics Canada		F				F				
• Monthly Railway Carloadings Survey	• Statistics Canada		F				F				
• Air Passenger Origin and Destination, Canada-U.S.A.	• Statistics Canada					P					
• Canadian International Merchandise Trade	• International Accounts and Trade										
• International Travel Survey (ITS)	• Tourism and the Centre for Education Statistics		P	P		P			P	P	P

Notes:
1. "F" means that this database provides freight data.
2. "P" means that this database provides passenger data.
3. POVs stands for private owned vehicles

Table D-2 North American Data Sources for Economic and Demographic Data

Data Type	Data Source
US- Population and Employment	US Census Bureau, American Community Survey
Canadian Population, Employment and related data	Statistics Canada, Government of Canada
Mexico Population, Employment and related data	Instituto Nacional de Estadistica Y Geografia (INEGI)

E. SPRING 2015 WORKSHOP SUMMARIES

E.1 WASHINGTON, D.C. WORKSHOP, FEBRUARY 24, 2015

FHWA executed the first of three workshops to support Task 4 of Scenario Planning of Future Freight and Passenger Traffic Flows across Border Regions project on February 24, 2015 at the National Highway Institute in Arlington, VA.

Over 300 potential participants were invited to participate in the DC workshop. FHWA and the Department of Commerce distributed invitations. Invitees that did not respond by an initial registration deadline were individually contacted by phone or email to encourage their participation. A total of 34 participants attended the workshop. The majority represented governmental agencies and industry associations.

ORGANIZATION	ATTENDEES	% OF TOTAL
U.S. Government	19	56%
U.S. Associations	6	18%
U.S. Chamber	2	6%
International Assoc.	1	3%
Freight Rail Carriers	1	3%
Intercity Bus Companies	1	3%
Developers/Real Estate	1	3%
Air Cargo Carriers	1	3%
Passenger Air Carriers	1	3%
Public Policy Organization	1	3%
Total =	**34**	**100%**

The workshop began with a welcome, and attendees were thanked for participating. The importance of the project in relation to its role with on-going USDOT efforts was discussed. Following the welcome, the overall project and its goals and objectives were discussed.

The morning session began with a presentation describing scenario planning and how it is a tool to prepare for the future, not predict it. A short introduction of each NCHRP 750 scenarios (*Naftástique*, *Millions of Markets*, *Global Marketplace*, and *One World Order*) was given and the participants dispersed into their respective breakout groups.

Scenario	PARTICIPANTS
Naftástique	10
One World Order	5
Global Marketplace	8
Millions of Markets	11
Total =	**34**

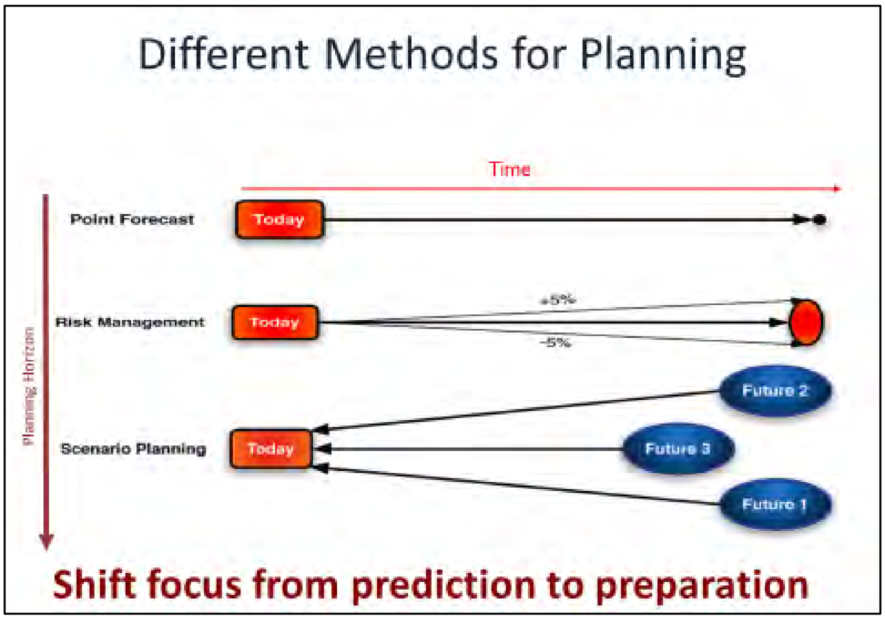


Figure 1: Scenario planning is a tool that can be used to better prepare for an uncertain future.

The attendees were divided into four breakout groups. Each of the breakouts were assigned one scenario and separated into difference conference rooms. Facilitators directed each group to identify the driving forces behind passenger and freight growth given the assigned scenario. In addition, the group undertook an exercise to gauge participants' thoughts on future passenger and freight growth.

The following includes a brief discussion of each scenario, identified driving forces, and flow exercise results that describe the magnitude and direction of change (total and by mode).

E.1.1 Naftástique!

E.1.1.1 Scenario Characteristics

- Government actions to prioritize meeting of local resource needs have created mostly self-contained blocs across the world. US is in NAMEC (North American Economic Community).
- People and goods move freely between the United States, Canada, and Mexico. People live, work, and retire anywhere within bloc.
- NAMEC is energy independent - from natural gas (#1 source), coal (close 2nd), and renewable energy (~20% of total energy mix).
- Manufacturing has returned to NAMEC.
    - Economic blocs are strong clusters. Freely flow of goods within blocs but limited between —mainly commodities not available within that bloc.
- Currency prices are stable within and across blocs.
- Energy prices are high but stable.
- Society and businesses are environmentally conscious — companies look to reduce waste. Environmental regulations are strong, but are bottom-up (instead of top-down as in One World Order - OWO).
- Political regulations are strong. They have created blocs but seek to facilitate free flow within blocs.

E.1.1.2 Driving Forces to Passenger Growth

- Overall the group saw tremendous increases in passenger crossings
- Higher incomes create larger disposable incomes which encourage crossings
- Easing of regulations on travel and immigration between Mexico-U.S.-Canada
- Greater interest in travel by visitors, friends and relatives (VFR)
- Improved infrastructure for passenger transportation at the borders
- Increase in alternatives for transportation by Privately Owned Vehicles (POVs)
- Shift to smaller regional sized aircraft
- Perception of security and safety concerns
- Repeal of cabotage rules
- Increase in retirement population near borders

E.1.1.3 Driving Forces to Freight Growth

- Overall the group saw tremendous increases in freight crossings
- Re-domestication of manufacturing to Mexico
- Wider adoption of short sea shipping up and down east and west coasts
- Increased capacity for freight border crossings
- Streamlined regulations for border crossings
- Repeal of the Jones Act
- Differing cost of labor persisting - more manufacturing in Mexico and therefore increasing border crossing

E.1.1.4 Future Flows

The group undertook an exercise to gauge how they thought the scenario would impact future flows by direction and mode. The results shown here are normalized to represent 0 as no change from today and range from +2 as strong positive growth and -2 as strong negative growth.

Naftástique! – Passenger Flows						
DIRECTION	POV	BUS	TRAIN	AIR	PEDESTRIAN	OVERALL
Canada to United States	1.00	0.50	0.50	0.70	0.00	0.90
United States to Canada	0.90	0.40	0.50	0.70	0.00	0.67
Mexico to United States	1.30	1.20	0.50	0.80	0.20	1.25
Canada to United States	0.60	0.50	1.00	0.10	0.00	1.00

Naftástique! – Freight Flows						
DIRECTION	TRUCK	RAIL	AIR	MARITIME	PIPELINE	OVERALL
Canada to United States	1.20	1.30	0.30	0.40	1.30	1.30
United States to Canada	1.30	1.00	0.30	0.10	0.40	1.20
Mexico to United States	1.70	1.60	0.70	0.30	0.80	1.70
Canada to United States	1.40	1.20	0.50	0.00	0.50	1.10

Note: Values range from -2 (strong negative growth) to +2 (strong positive growth)

E.1.2 One World Order

E.1.2.1 Scenario Characteristics

- Vital resources — energy, water, minerals, etc. — are scarce.
- Governments have created the World Sustainable Trade Organization (WSTO). It has both reach and teeth and is seen as crucial in keeping order and peace.
- Global trade has transformed, from chaotic market-based globalization to an ordered, less volatile and more predictable process.
- Although the invisible hand of the market still decides 'what' and 'where' to produce, it is the visible hand of regulation that dictates the 'how'.
- Firms have adapted to a highly regulated environment.
- The objective of the WSTO regulations is to achieve a long-term global solution, not short-term firm profits.
- Most governments lobby the WSTO heavily to sway the regulations to favor their own resources and requirements.
- Government agencies at all levels (federal, state, local) have enacted regulations on emissions, sewage, recycling, garbage, and most other aspects. Cities grow bigger, yet the per-capita environmental impact decreases.
- Government discourages the home delivery of small/cheap packages through taxes and fees.
- Consolidation centers emerge in cities, to aggregate deliveries.
- Manufacturers have created large-scale production clusters and ultra-efficient supply chains.

E.1.2.2 Driving Forces to Passenger Growth

- Fractional vehicle ownership
- Automated vehicles
- Less demand for long distance travel
- Need based travel vs. want based travel
- Less global tourism
- Passenger flights decrease (and less airport hubs)
- Mass migrations to water and energy sources (shift from southern U.S. to north)
- Mindful of cultural drivers for passenger travel
- More transit and walking
- Rational travel decisions based on price (price will increase substantially)
- Regionalism/Mega Regions will grow

E.1.2.3 Driving Forces to Freight Growth

- Consolidation of distribution networks and markets
- Shifts in agricultural areas
- Recycling (Reverse Logistics)
- Freight travel will shift to population centers with access to ports
- Inland waterway demand, including fresh drinking water
- Agriculture will shift from inland waterways to rail network because of water demand
- Expanded North/South rail network needed
- Rail innovation must happen
- Unmanned aerial vehicles (UAV) for urban trips to move high cost and speed freight

- Ports will be utilized near populations centers (that have port capacity)
- Trucks will be run on electricity
- Black market will emerge

E.1.2.4 Future Flows

The group undertook an exercise to gauge how they thought the scenario would impact future flows by direction and mode. The results shown here are normalized to represent 0 as no change from today and range from +2 as strong positive growth and -2 as strong negative growth.

One World Order – Passenger Flows						
DIRECTION	POV	BUS	TRAIN	AIR	PEDESTRIAN	OVERALL
Canada to United States	-1.00	1.00	1.00	-1.00	0.20	-0.30
United States to Canada	-0.80	0.80	1.20	-1.00	0.20	0.65
Mexico to United States	-1.20	1.20	1.00	-1.00	0.80	0.85
Canada to United States	-0.80	0.60	1.00	-1.00	0.60	-0.80

One World Order – Freight Flows						
DIRECTION	TRUCK	RAIL	AIR	MARITIME	PIPELINE	OVERALL
Canada to United States	1.00	1.20	-0.20	0.20	1.60	0.55
United States to Canada	1.00	1.00	-0.20	0.20	0.60	0.35
Mexico to United States	0.80	1.20	-0.20	0.80	0.80	0.45
Canada to United States	0.80	1.00	-0.20	0.80	0.80	0.55

Note: Values range from -2 (strong negative growth) to +2 (strong positive growth)

E.1.3 Global Marketplace

E.1.3.1 Scenario Characteristics

- Significant global trade that involves most countries — high level of collaboration across nations.
- Very high volatility in the supply of goods, currency values, and commodity prices.
- High level of virtual trade (intellectual property).
- Supply chains are very versatile yet reasonable in cost.
- Energy is cheap and available, yet the prices are highly volatile.
- Distributed global manufacturing footprint for most large companies.
- People prefer to live in large and dense cities — mega-cities are fast growing.
- Global companies achieve and leverage economies of scale.
- Governmental regulations exist mainly to support global trade.

E.1.3.2 Driving Forces to Passenger Growth

- The Environment
  - Climate change will lead to warmer temperature in Canada which in turn is likely to increase freight movement from Canada to the United States
  - Existing and future U.S. environmental regulations will likely impede economic growth in the United States pushing businesses to places like Mexico
  - With more relaxed trade regulations, freight activities are likely to increase between the U.S. and Canada and the U.S. and Mexico. This in turn will lead to significant increase in pollution.
  - With growing economic needs, the environmental cost of energy may increase significantly. Policymakers and environmental experts need to begin to develop policies that mitigate the environmental as well as the financial costs of increased energy consumption.
- Emerging Market
  - The global marketplace will witness growing demands in emerging markets. With relaxed trade regulations, business is expected to increase between North America and emerging markets including India
- System Modernization
  - Growth in freight demand to/from the United States will demand increased investment in transportation:
    - Funding maintaining and operating the existing system
    - Funding for capacity increases at existing entry ports (land, sea, air)
    - Funding for additional ports of entry
    - Funding for distribution centers
    - Funding for multimodal connectivity
    - Funding for technology to improve system management and sharing, freight safety particularly at it relates to moving hazardous materials, and system security (data sharing, managing freight flows at ports of entry into and out of the U.S.)
- Policy
  - With increased freight activities, there is a need to:

        - Defining the role of the public and private sector in funding and managing the transportation sector
        - Investing in education and the development of a workforce that can address the business needs of the future
        - Invest in a flexible transportation system that promotes multimodalism
- Other
    - As technology continues to advance, work remotely is likely to gain further grown in North America
    - New immigration laws and relaxed trade regulations are could also lead to regional as well as global nomadism where people live in a country of their choice and work for a company based in another
    - With growing demand for business in emerging markets, North American jobs and consequently people could migrate to locations such as India, China, and elsewhere.

E.1.3.3 Driving Forces to Freight Growth

- The group believes the global marketplace scenario is focused more on goods rather than people movement
- Increased pollution due to growth in economy is likely to push for internal migration within North America and elsewhere
- Telecommuting and/or working remotely is likely to increase as a result of social media, advanced technological advances, and faster and more reliable communication and internet services. Work will be driven by technological enablers.
- In addition, people are likely to migrate to where the jobs are. These could be in emerging markets such as India, specific states in the United States (such as the Dakotas) as well as Mexico, and potentially Canada (with climate change and warmer temperatures)
- Increased demographics can lead to resource scarcity including water (water shortages), energy, raw materials, etc.
- Air travel and air travel regulation are likely to change in a global marketplace world. Pre-clearance could become a prerequisite.
- Multimodalism might increase. Rail could become the preferred mode of travel for short-haul trips. Air could become the preferred mode of travel for long-haul trips.
- By 2037, most cars will be enabled with connected and automated vehicle technologies.

E.1.3.4 Future Flows

The group undertook an exercise to gauge how they thought the scenario would impact future flows by direction and mode. The results shown here are normalized to represent 0 as no change from today and range from +2 as strong positive growth and -2 as strong negative growth.

Global Marketplace – Passenger Flows						
DIRECTION	POV	BUS	TRAIN	AIR	PEDESTRIAN	OVERALL
Canada to United States	0.50	0.25	0.75	1.00	0.25	0.38
United States to Canada	0.63	0.50	0.88	0.75	-0.13	0.25
Mexico to United States	1.38	0.75	1.25	1.38	1.0	1.25
Canada to United States	1.38	0.50	0.75	1.38	0.63	0.70

Note: Values range from -2 (strong negative growth) to +2 (strong positive growth)

Global Marketplace – Freight Flows						
DIRECTION	TRUCK	RAIL	AIR	MARITIME	PIPELINE	OVERALL
Canada to United States	0.88	1.50	0.75	0.88	1.50	0.49
United States to Canada	1.13	1.38	1.00	0.38	0.38	0.63
Mexico to United States	1.50	1.75	0.88	1.13	0.88	1.40
Canada to United States	1.38	1.50	0.88	0.75	0.75	1.30

E.1.4 Millions of Markets

E.1.4.1 Scenario Characteristics

- The world has transformed into many self-sufficient clusters — countries and regions.
- Population is dispersed. The greatest population growth occurs in mid-sized cities.
- People prefer personalized and customized products.
- The U.S. is energy independent, mainly through natural gas and nuclear energy.
- Technology allows material to be maintained in the raw form until when needed for production (which is done close to the market).
- Intellectual property is in smart materials and technologies that allow postponed production.
- Markets are mostly regional with demand being met by local supply
- Technological innovations have lowered economies of scale so that customized production in small batches is economically sound.
- Supply chains mostly carry undifferentiated/raw material for long distance and differentiated goods for short distance. (Undifferentiated material need not be cheap).
- People reuse & recycle — technology enables better recapture of the raw materials.
- Regulations focus on protecting intellectual property.
- Regional governments compete to make their region more attractive for businesses investment.
- There is a growing "digital divide" between blue collar and no-collar workers

E.1.4.2 Driving Forces to Passenger Growth

- Key Issues Influencing Travel Demand in the Future
  - Tourism – With increase work flexibility and more disposable income, voluntary travel will surge
  - Business travel will decline slightly as more meetings are virtual
  - Energy costs are lower, facilitating travel
  - Immigration policy is presumably relaxed, enabling free movement of people for voluntary travel
- Passenger Direction
  - More travel to/from Canada
  - Less business travel, more tourism = no net change
  - Millennials, untethered by technology, will be able to telecommute from Mexico
  - Borders become more virtual
  - A growing Hispanic population in U.S. with ties to Mexico will drive increased cross-border travel demand. Growth also driven by increasing disposable income of Mexican middle class
- Modes and Growth on Both Borders
  - The future will see a reduction in passenger vehicles crossing the border
  - Air travel between the U.S. and Canada will increase slightly (driven by cheaper oil)
  - Major growth in U.S.-Mexico air travel market due to liberalized air services
  - Major increases in bus travel between the U.S. and Mexico, although more increase from Mexico to the U.S. than from U.S. to Mexico

E.1.4.3 Driving Forces to Freight Growth

- Which Factors will Affect Freight Demand
  - Materials from Canada will drive demand
  - Local supply chains will mean a reduction in long haul goods movement demand
  - The Panama Canal expansion will create new demands for East / Gulf Coast Ports
  - Major flows of plastics from Mexico (Pemex) to U.S., in part to drive 3D printing demands
  - Some freight will persist, even in an age of 3D printing
- Freight direction by mode
  - Between U.S. and Canada
    - Pipeline and rail will increase significantly due to raw materials demand
    - Truck will also increase due to decentralization (Millions of Markets)
  - Between Mexico and the U.S.
    - Maritime (demand for raw goods), pipelines (energy), and air cargo (middle class demand) will all increase; yet trucking demand will wane slightly

E.1.4.4 Future Flows

The group undertook an exercise to gauge how they thought the scenario would impact future flows by direction and mode. The results shown here are normalized to represent 0 as no change from today and range from +2 as strong positive growth and -2 as strong negative growth.

Millions of Markets – Passenger Flows						
DIRECTION	POV	BUS	TRAIN	AIR	PEDESTRIAN	OVERALL
Canada to United States	0.36	0.45	0.45	1.00	-0.09	0.18
United States to Canada	0.00	0.36	0.27	0.90	-0.18	-0.09
Mexico to United States	0.45	1.00	0.18	1.18	0	0.64
Canada to United States	0.45	0.45	0.09	1.18	-0.09	1.00

Millions of Markets – Freight Flows						
DIRECTION	TRUCK	RAIL	AIR	MARITIME	PIPELINE	OVERALL
Canada to United States	0.55	0.81	0	0.18	0.81	0.36
United States to Canada	0.67	0.72	0	-0.09	0.27	0.63
Mexico to United States	0.90	1.20	0.36	0.36	0.36	0.64
Canada to United States	0.55	0.64	0.09	0.09	0.18	0.72

Note: Values range from -2 (strong negative growth) to +2 (strong positive growth)

E.1.5 Conclusions

The afternoon discussion centered on comparing the four scenario flow exercises. This discussion included each breakout group presenting the driving forces described above, followed by a presentation that showed how each scenario's flow exercise compared to each other. Similar to the other flow charts in this document, results shown here are normalized to represent 0 as no change from today and range from +2 as strong positive growth and -2 as strong negative growth.

Passenger Cross Scenario Comparisons (CANADA – U.S.)							
SCENARIO	DIRECTION	POV	BUS	TRAIN	AIR	PEDESTRIAN	OVERALL
Naftástique!	CAN to US	1.00	0.50	0.50	0.70	0	0.90
	US to CAN	0.90	0.40	0.50	0.70	0	0.67
One World Order	CAN to US	-1.00	1.00	1.00	-1.00	0.20	-0.30
	US to CAN	-0.80	0.80	1.20	-1.00	0.20	0.65
Global Marketplace	CAN to US	0.50	0.25	0.75	1.00	0.25	0.38
	US to CAN	0.63	0.50	0.88	0.75	-0.13	0.25
Millions of Markets	CAN to US	0.36	0.45	0.45	1.00	-0.09	0.18
	US to CAN	0.00	0.36	0.27	0.90	-0.18	-0.09

Freight Cross Scenario Comparisons (CANADA – U.S.)							
SCENARIO	DIRECTION	TRUCK	RAIL	AIR	MARITIME	PIPELINE	OVERALL
Naftástique!	CAN to US	1.20	1.30	0.30	0.40	1.30	1.30
	US to CAN	1.30	1.00	0.30	0.10	0.40	1.20
One World Order	CAN to US	1.00	1.20	-0.20	0.20	1.60	0.55
	US to CAN	1.00	1.00	-0.20	0.20	0.60	0.35
Global Marketplace	CAN to US	0.88	1.50	0.75	0.88	1.50	0.49
	US to CAN	1.13	1.38	1.00	0.38	0.38	0.63
Millions of Markets	CAN to US	0.55	0.81	0.00	0.18	0.81	0.36
	US to CAN	0.67	0.72	0.00	-0.09	0.27	0.63

Passenger Cross Scenario Comparisons (MEXICO – U.S.)							
SCENARIO	DIRECTION	POV	BUS	TRAIN	AIR	PEDESTRIAN	OVERALL
Naftástique!	MEX to US	1.30	1.20	0.50	0.80	0.20	1.25
	US to MEX	0.60	0.50	1.00	0.10	0	1.00
One World Order	MEX to US	-1.20	1.20	1.00	-1.00	0.80	0.85
	US to MEX	-0.80	0.60	1.00	-1.00	0.60	-0.80
Global Marketplace	MEX to US	1.38	0.75	1.25	1.38	1.00	1.25
	US to MEX	1.38	0.50	0.75	1.38	0.63	0.70
Millions of Markets	MEX to US	0.45	1.00	0.18	1.18	0	0.64
	US to MEX	0.45	0.45	0.09	1.18	-0.09	1.00

Freight Cross Scenario Comparisons (MEXICO – U.S.)							
SCENARIO	DIRECTION	TRUCK	RAIL	AIR	MARITIME	PIPELINE	OVERALL
Naftástique!	MEX to US	1.70	1.60	0.70	0.30	0.80	1.70
	US to MEX	1.40	1.20	0.50	0.00	0.50	1.10
One World Order	MEX to US	0.80	1.20	-0.20	0.80	0.80	0.45
	US to MEX	0.80	1.00	-0.20	0.80	0.60	0.55
Global Marketplace	MEX to US	1.50	1.75	0.88	1.13	0.88	1.40
	US to MEX	1.38	1.50	0.88	0.75	0.75	1.30
Millions of Markets	MEX to US	0.90	1.20	0.36	0.36	0.36	0.64
	US to MEX	0.55	0.64	0.09	0.09	0.18	0.72

Note: Values range from -2 (strong negative growth) to +2 (strong positive growth)

E.1.6 Current Investment Needs

The workshop ended with an exercise to gauge where the participants felt major investment would need to take place after hearing the results of the four breakout sessions. Red chips represent freight investment and white chips passenger.

The project team executed a short survey to expand on this past exercise. Workshops participants were asked to respond to open ended questions regarding their thoughts investment needs. Responses were very limited. Only two participants responded. However, their responses were very insightful. Both focused on the U.S. border with Mexico and suggested changes to make the border more efficient. They believed this could be accomplished through technological solutions such as implementing a program like the known-traveler program used for passenger aircraft travel, but for cargo crossing the border. Similarly, respondents also were concerned with emissions near the land border crossings due to idling. While the response rate was low, it is interesting that all responses received were operational or policy improvements, not traditional capacity expansion investment needs.

E.2 OTTAWA WORKSHOP, MARCH 11, 2015

FHWA executed the second of three workshops to support Task 4 of Scenario Planning of Future Freight and Passenger Traffic Flows across Border Regions project on March 11, 2015 at the Ottawa Marriott in downtown Ottawa.

Over 250 potential participants were invited to participate in the Ottawa workshop. FHWA and Transport Canada distributed invitations. Invitees that did not respond by an initial registration deadline were individually contacted by phone or email to encourage their participation. A total of 45 people attended the workshop (40 participants, 5 observers). The majority represented governmental agencies and industry associations.

ORGANIZATION	ATTENDEES	% OF TOTAL
Canadian Government/Provinces	18	45.5%
Canadian/Binational Associations	11	27.5%
Bridge Authorities	5	12.5%
Chamber of Marine Commerce	1	2.5%
Academia	1	2.5%
Freight Rail Carriers	2	5.0%
Trade Corridors	1	2.5%
U.S. Government	1	2.5%
Total =	**40**	**100.0%**

The workshop began with a welcome and discussion of the overall project and its goals and objectives. After the welcome, there was a brief overview of changes in population, Gross Domestic Product (GDP), and GDP per capita in the U.S., Canada and Mexico from 1995 to 2013, passenger and freight cross-border flows along the U.S.-Canada Border after the NAFTA agreement was signed in 1994, and relevant figures on the U.S.-Canada trade relationship.

The morning session began with a presentation describing scenario planning and how it is a tool to prepare for the future, not predict it. A short introduction of each NCHRP 750 scenarios (*Naftástique*, *Millions of Markets*, *Global Marketplace*, and *One World Order*) was given and the participants broke into their respective breakout groups.

Scenario	PARTICIPANTS
Naftástique	10
One World Order	10
Global Marketplace	10
Millions of Markets	10
Total =	**40**

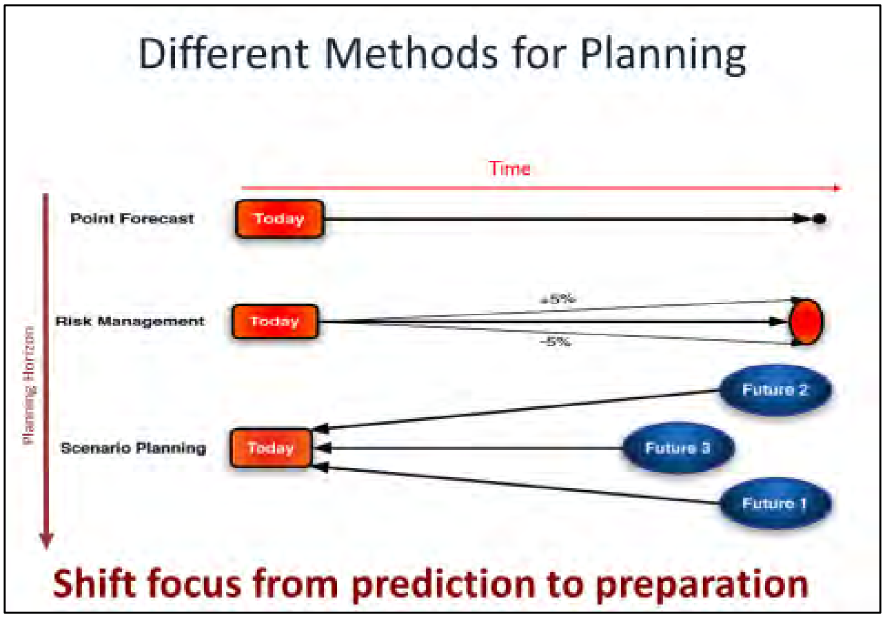


Figure 2: Scenario planning is a tool that can be used to better prepare for an uncertain future.

The attendees were divided into four breakout groups. Each of the breakouts were assigned one scenario and separated into difference conference rooms. Facilitators directed each group to identify the driving forces behind passenger and freight growth given the assigned scenario. In addition, the group undertook an exercise to gauge participants' thoughts on future passenger and freight growth.

The following includes a brief discussion of each scenario, identified driving forces, and flow exercise results that describe the magnitude and regional flow.

E.2.1 Naftástique!

E.2.1.1 Scenario Characteristics

- Government actions to prioritize meeting of local resource needs have created mostly self-contained blocs across the world. The U.S. is in NAMEC (North American Economic Community).
- People and goods move freely between the United States, Canada, and Mexico. People live, work, and retire anywhere within bloc.
- NAMEC is energy independent - from natural gas (#1 source), coal (close 2nd), and renewable energy (~20% of total energy mix).
- Manufacturing has returned to NAMEC.
    - Economic blocs are strong clusters. Freely flow of goods within blocs but limited between —mainly commodities not available within that bloc.
- Currency prices are stable within and across blocs.
- Energy prices are high but stable.
- Society and businesses are environmentally conscious — companies look to reduce waste. Environmental regulations are strong, but are bottom-up (instead of top-down as in One World Order - OWO).
- Political regulations are strong. They have created blocs but seek to facilitate free flow within blocs.

E.2.1.2 Driving Forces to Passenger Growth

- Labor mobility increases the amount of cross-border movements
- Thinning and almost blurring of borders due to reduced regulation and required documentation
- Greater interest in travel by visitors, friends and relatives (VFR)
- Larger number of retirees along the border between Mexico and Canada increase travel
- Less desire for cross-border shopping travel if borders are thin - nothing new
- Higher energy prices might discourage longer travel over borders
- Growth in bilingual population might increase desire for tourism to other areas - less apprehension to language barriers
- Single continent travel/ID card (Nexus like) will increase North American passenger movements
- Increased use of Internet for shopping will decrease cross-border shopping trips
- As the economies of Mexico, Canada and the U.S. stabilize and equalize, the level of economic immigration will drop

E.2.1.3 Driving Forces to Freight Growth

- Greater intra-regional trade will increase cross-border sourcing and thus freight moves
- Trade barriers on inter-bloc movements will increase intra-bloc trade
- Re-domestication of manufacturing to Mexico
- More intra-bloc trade will shift major trade lanes from East-West to North-South
- As security concerns lessen, freight flow will increase
- Harmonization of markets, product specifications, food regulations, etc., will lead to more cross border moves and less “country specific” products (e.g. Non-caffeine Mountain Dew in Canada)

- Access to greater labor pool might lessen truck driver shortage
- Increased capacity for freight border crossings
- Streamlined regulations for border crossings

E.2.1.4 Future Flows

The group undertook an exercise to gauge how they thought the scenario would impact future flows by direction. The results shown here are normalized to represent 0 as no change from today and range from +2 as strong positive growth and -2 as strong negative growth.

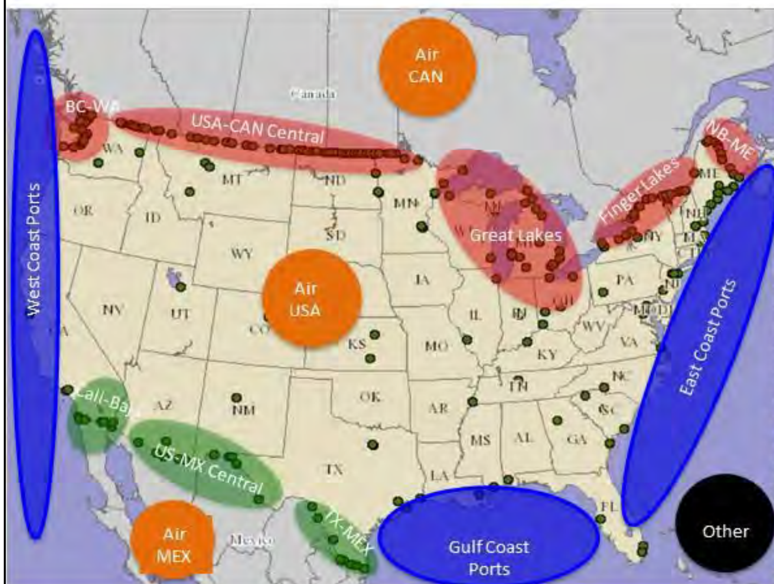
Naftástique! – Flows		
DIRECTION	PASSENGER	FREIGHT
Canada to United States	1.5	1.8
United States to Canada	1.2	1.5
Mexico to United States	1.8	1.5
United States to Mexico	1.2	1.1
Canada to Mexico	1.0	1.1
Mexico to Canada	0.8	1.0

Note: Values range from -2 (strong negative growth) to +2 (strong positive growth)

Similarly, the group was asked to define where the growth would take place for passenger and freight flows. Each participant was given 12 points for passenger and 15 points for freight to allocate across the regions displayed on the map, for a total of 120 points for passenger and 150 points for freight. The freight allocation was increased by 3 points to account for three additional regions that were particular to freight movement. Participants could place all their points in one region, or spread them out across the regions in any fashion. For passenger flows, 93 percent of the total points were allocated across the regions where personal travel is expected to increase. For freight flows, 88 percent of the total points were allocated across the regions where cargo movements are expected to increase.

Regional Flows

Naftástique!



Region	% PAX	% FRGT
BC-WA	8%	12%
USA-CAN Central	4%	6%
Great Lakes	16%	18%
Finger Lakes	8%	4%
NB-ME	0%	1%
Cali-Baja	11%	3%
USA-MEX Central	5%	8%
TX-MX	13%	11%
Air CAN	7%	1%
Air USA	11%	5%
Air MEX	11%	2%
East Coast	N/A	6%
Gulf Coast	N/A	9%
West Coast	N/A	0%
Other	0%	0%
Total (%) =	**93%**	**88%**

E.2.2 One World Order

E.2.2.1 Scenario Characteristics

- Vital resources — energy, water, minerals, etc. — are scarce.
- Governments have created the World Sustainable Trade Organization (WSTO). It has both reach and teeth and is seen as crucial in keeping order and peace.
- Global trade has transformed, from chaotic market-based globalization to an ordered, less volatile and more predictable process.
- Although the invisible hand of the market still decides 'what' and 'where' to produce, it is the visible hand of regulation that dictates the 'how'.
- Firms have adapted to a highly regulated environment.
- The objective of the WSTO regulations is to achieve a long-term global solution, not short-term firm profits.
- Most governments lobby the WSTO heavily to sway the regulations to favor their own resources and requirements.
- Government agencies at all levels (federal, state, local) have enacted regulations on emissions, sewage, recycling, garbage, and most other aspects. Cities grow bigger, yet the per-capita environmental impact decreases.
- Government discourages the home delivery of small/cheap packages through taxes and fees.
- Consolidation centers emerge in cities, to aggregate deliveries.
- Manufacturers have created large-scale production clusters and ultra-efficient supply chains.

E.2.2.2 Driving Forces to Passenger Growth

- Less Leisure travel
- One North American transportation system
- Air traffic significantly decreases
- Increased telecommunications (telecommuting, web-based meetings, etc.)
- More business travel, less personal
- Passenger trips local and constrained
- Smarter transportation option used
- Shift to environmental friendly modes
- Travel across borders increase
- Renewal energy innovation demanded
- Labor resources travel to where the jobs are
- Migration from lesser to mores
- More consolidation of population centers
- Less highway links, but used more

E.2.2.3 Driving Forces to Freight Growth

- Increased production clusters
- Slower trade
- Scarcity of resources = Price of goods increase
- More large firms, less smaller ones
- Centrally planned freight movement
- Freight will be a function of population growth

- Exchange rate will largely drive trade
- Cross-border manufacturing corridors will grow
    - o Including new ones in rustbelt cities
    - o Especially in Great Lakes Region
- Increased manufacturing specialization
- New rail corridors will be needed (North/South)
    - o Mode split to rail across border
- Central Canada freight flow will increase because of raw material production
- Border will go away as trade increases along corridors

E.2.2.4 Future Flows

The group undertook an exercise to gauge how they thought the scenario would impact future flows by direction. The results shown here are normalized to represent 0 as no change from today and range from +2 as strong positive growth and -2 as strong negative growth.

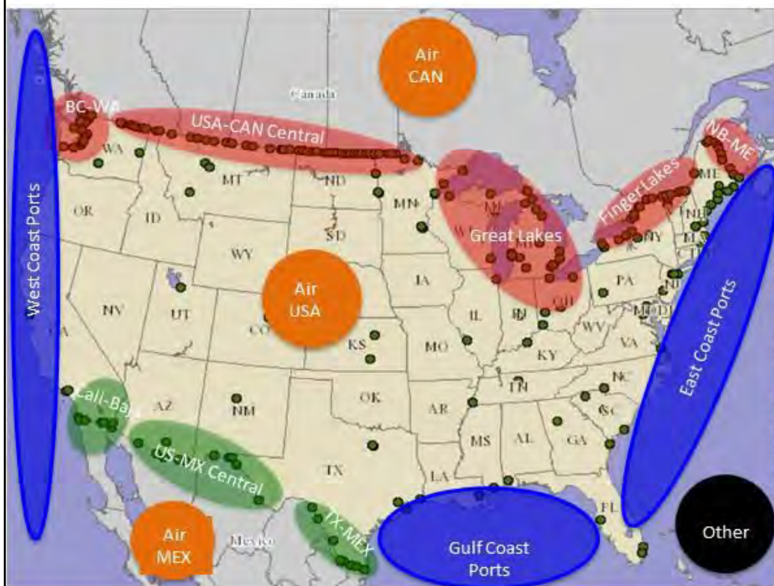
One World Order – Flows		
DIRECTION	PASSENGER	FREIGHT
Canada to United States	0.3	1.3
United States to Canada	0.3	0.6
Mexico to United States	0.7	1.3
United States to Mexico	0.4	0.9
Canada to Mexico	0.4	0.5
Mexico to Canada	0.4	0.0

Note: Values range from -2 (strong negative growth) to +2 (strong positive growth)

Similarly, the group was asked to define where the growth would take place for passenger and freight flows. Each participant was given 12 points for passenger and 15 points for freight to allocate across the regions displayed on the map, for a total of 120 points for passenger and 150 points for freight. The freight allocation was increased by 3 points to account for three additional regions that were particular to freight movement. Participants could place all their points in one region, or spread them out across the regions in any fashion. For passenger flows, 68 percent of the total points were allocated across the regions where personal travel is expected to increase. For freight flows, 89 percent of the total points were allocated across the regions where cargo movements are expected to increase.

Regional Flows

ONE WORLD ORDER



Region	% PAX	% FRGT
BC-WA	5%	9%
USA-CAN Central	3%	5%
Great Lakes	11%	12%
Finger Lakes	4%	3%
NB-ME	2%	3%
Cali-Baja	13%	5%
USA-MEX Central	9%	7%
TX-MX	13%	7%
Air CAN	2%	1%
Air USA	3%	1%
Air MEX	3%	1%
East Coast	N/A	11%
Gulf Coast	N/A	9%
West Coast	N/A	12%
Other	2%	3%
Total (%) =	68%	89%

E.2.3 Global Marketplace

E.2.3.1 Scenario Characteristics

- Significant global trade that involves most countries — high level of collaboration across nations.
- Very high volatility in the supply of goods, currency values, and commodity prices.
- High level of virtual trade (intellectual property).
- Supply chains are very versatile yet reasonable in cost.
- Energy is cheap and available, yet the prices are highly volatile.
- Distributed global manufacturing footprint for most large companies.
- People prefer to live in large and dense cities — mega-cities are fast growing.
- Global companies achieve and leverage economies of scale.
- Governmental regulations exist mainly to support global trade.

E.2.3.2 Driving Forces to Passenger Growth

- Value of time/Low energy/easier travel cost leads to increased air travel
- Advanced technology leads to growing number of citizens telecommuting and/or conducting virtual video-based conferences/meetings
- Seasonal movements – Workers may work in different locations depending on the seasons
- Growing older population and options for global retirement will increase
- Low skill jobs could potentially move from Canada and the U.S. to Mexico
- High skilled jobs from Mexico to migrate to the U.S.
- Migration from Canada to the U.S. and vice versa for job opportunities

E.2.3.3 Driving Forces to Freight Growth

- Growing volume of goods in transit through North America
- Diversification of the transportation system. Less focus on LA/Long Beach and Chicago and more on Port Rupert in Canada and Mexican Ports
- Increased investments in transportation in North America
- Significant percent increase in air freight travel should lead to additional investment in air freight transportation. Even if the volume of air freight travel is comparatively low.

E.2.3.4 Future Flows

The group undertook an exercise to gauge how they thought the scenario would impact future flows by direction and mode. The results shown here are normalized to represent 0 as no change from today and range from +2 as strong positive growth and -2 as strong negative growth.

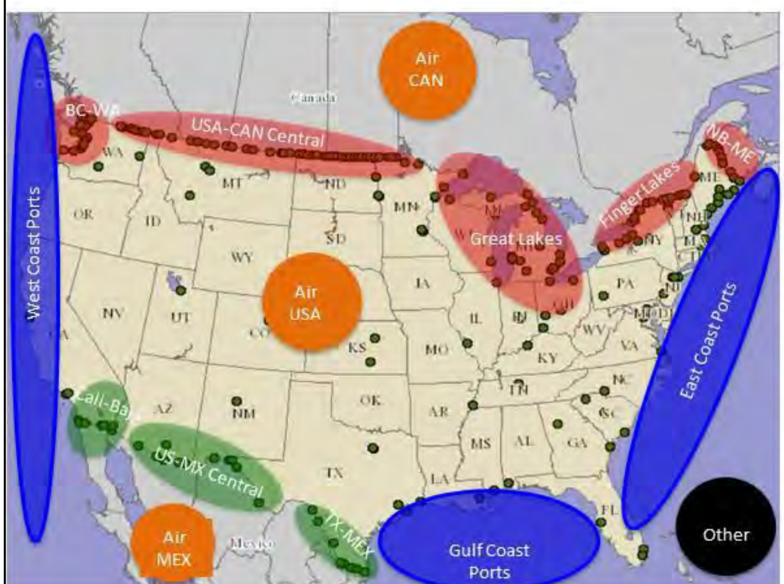
Global Marketplace – Flows		
DIRECTION	PASSENGER	FREIGHT
Canada to United States	1.0	1.3
United States to Canada	1.6	0.8
Mexico to United States	1.7	1.7
United States to Mexico	1.4	1.00
Canada to Mexico	1.4	0.8
Mexico to Canada	1.3	1.3

Note: Values range from -2 (strong negative growth) to +2 (strong positive growth)

Similarly, the group was asked to define where the growth would take place for passenger and freight flows. Each participant was given 12 points for passenger and 15 points for freight to allocate across the regions displayed on the map, for a total of 120 points for passenger and 150 points for freight. The freight allocation was increased by 3 points to account for three additional regions that were particular to freight movement. Participants could place all their points in one region, or spread them out across the regions in any fashion. For passenger flows, 93 percent of the total points were allocated across the regions where personal travel is expected to increase. For freight flows, 89 percent of the total points were allocated across the regions where cargo movements are expected to increase.

Regional Flows

Global Marketplace



Region	% PAX	% FRGT
BC-WA	8%	6%
USA-CAN Central	3%	9%
Great Lakes	9%	9%
Finger Lakes	2%	3%
NB-ME	0%	1%
Cali-Baja	11%	8%
USA-MEX Central	6%	7%
TX-MX	13%	7%
Air CAN	8%	2%
Air USA	11%	5%
Air MEX	15%	4%
East Coast	N/A	9%
Gulf Coast	N/A	5%
West Coast	N/A	11%
Other	9%	4%
Total (%) =	**93%**	**89%**

E.2.4 Millions of Markets

E.2.4.1 Scenario Characteristics

- The world has transformed into many self-sufficient clusters — countries and regions.
- Population is dispersed. The greatest population growth occurs in mid-sized cities.
- People prefer personalized and customized products.
- The US is energy independent, mainly through natural gas and nuclear energy.
- Technology allows material to be maintained in the raw form until when needed for production (which is done close to the market).
- Intellectual property is in smart materials and technologies that allow postponed production.
- Markets are mostly regional with demand being met by local supply
- Technological innovations have lowered economies of scale so that customized production in small batches is economically sound.
- Supply chains mostly carry undifferentiated/raw material for long distance and differentiated goods for short distance. (Undifferentiated material need not be cheap).
- People reuse & recycle — technology enables better recapture of the raw materials.
- Regulations focus on protecting intellectual property.
- Regional governments compete to make their region more attractive for businesses investment.
- There is a growing "digital divide" between blue collar and no-collar workers

E.2.4.2 Driving Forces to Passenger Growth

- Increase in personal travel for leisure/tourism
    - More disposable income will mean higher demand for travel (even among lower income groups, given lower cost of fuel, products, etc. which could lead to induced travel)
- But decrease in cross-border shopping (due to greater on-line purchasing)
- Decrease in business travel due to improved communications technology (although increase in business travel relating to service sectors, IP, etc.)
- More air travel but less use of personal cars for personal travel across borders.
- Net decrease in work related travel but increase in non-work related visits
    - Air preferred mode for cross border trips
- That Canadians make up 75 percent of trips across the U.S.-Canada border (all modes)
- Air (Canada and the U.S.) will be primary mode of travel for personal travel
- BC-Washington will see disproportionate growth in passenger travel
    - People will gravitate to the smaller West Coast regions (the Portlands of the North American)
- Increased connectedness of people via information technology
- On the socio-economic level, wider income gaps (creative types vs. no collars), but more of a creative class (that do very well).
- Overall increase in quality of life (e.g. more personal time, less time spent commuting, etc.)

E.2.4.3 Driving Forces to Freight Growth

- Canada continues to be a global resource base for raw materials and will continue to export these to the U.S. and the world (largely in bulk, using rail/marine)

- With the regionalization/decentralization of manufacturing, there will be in drop in the movement of manufactured goods across the border.
- There will likewise be a drop in intermodal traffic, since manufacturing shifts away from major global centers such as Asia.
- Subtlety – increase in bulk exports to the U.S. by rail, but reduction in trucks (but possibly more Less Than Truckload (LTL) for online ordering world).
- Overall decrease due to reduction of trade in manufactured goods or use of U.S. corridors to reach Canadian markets (due to drop in international trade in goods).
- Densification will lead to lower volumes of cargo moving around and crossing the borders
- East and West Coast ports – largely relating to export of raw materials, and short sea shipping
    - Panama Canal also likely to influence push towards East coast.
    - Global trade will likely manifest itself in marine imports, and then rail movements to inland markets.
- 3D printing = less physical delivery, but increase in virtual delivery (data/designs, etc.)
- Since production is more local, so too are distribution activities (fewer Distribution Centers (DCs), long-haul full truck loads, etc.)
- More transportation of raw material from sources to end markets (limited change in sources of natural resources)
- Overall distance of freight movement will decrease as supply chains shorten and become more local
- Smaller scale, but more regions of productions (to coincide with decentralization of populations (markets) and production processes.
- Competition for investment and talent / innovation
    - Hubs of specialization
- Technology = densification (things are smaller)

E.2.4.4 Future Flows

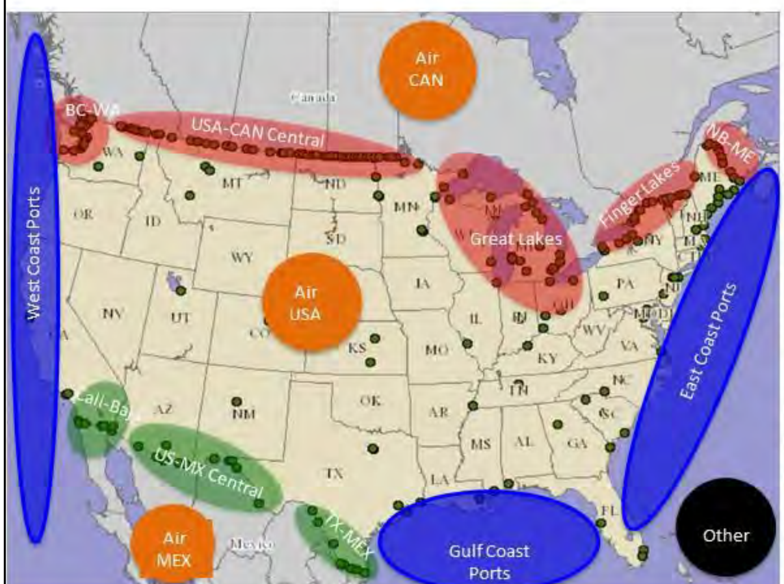
The group undertook an exercise to gauge how they thought the scenario would impact future flows by direction. The results shown here are normalized to represent 0 as no change from today and range from +2 as strong positive growth and -2 as strong negative growth.

Millions of Markets – Flows DIRECTION	PASSENGER	FREIGHT
Canada to United States	0.2	-0.3
United States to Canada	0.1	-0.9
Mexico to United States	0.3	0.3
United States to Mexico	0.0	-0.3
Canada to Mexico	0.4	-0.4
Mexico to Canada	-0.2	-0.5

Note: Values range from -2 (strong negative growth) to +2 (strong positive growth)

Similarly, the group was asked to define where the growth would take place for passenger and freight flows. Each participant was given 12 points for passenger and 15 points for freight to allocate across the regions displayed on the map, for a total of 120 points for passenger and 150 points for freight. The freight allocation was increased by 3 points to account for three additional regions that were particular to freight movement. Participants could place all their points in one region, or spread them out across the regions in any fashion. For passenger flows, 66 percent of the total points were allocated across the regions where personal travel is expected to increase. For freight flows, 53 percent of the total points were allocated across the regions where cargo movements are expected to increase.

Regional Flows



MILLIONS OF MARKETS

Region	% PAX	% FRGT
BC-WA	10%	6%
USA-CAN Central	2%	5%
Great Lakes	5%	4%
Finger Lakes	5%	5%
NB-ME	0%	1%
Cali-Baja	1%	1%
USA-MEX Central	0%	1%
TX-MX	0%	0%
Air CAN	19%	6%
Air USA	22%	6%
Air MEX	3%	2%
East Coast	N/A	7%
Gulf Coast	N/A	4%
West Coast	N/A	6%
Other	0%	0%
Total (%) =	66%	53%

E.2.5 Conclusions

The afternoon discussion centered on comparing the four scenario flow exercises. This discussion included each breakout group presenting the driving forces described above, followed by a presentation that showed how the each scenario's flow exercise compared to each other. Similar to the other flow charts in this document, results shown here are normalized to represent 0 as no change from today and range from +2 as strong positive growth and -2 as strong negative growth.

Passenger Flows DIRECTION	NAFTASTIQUE!	ONE WORLD ORDER	GLOBAL MARKETPLACE	MILLIONS OF MARKETS
Canada to United States	1.5	0.3	1.0	0.2
United States to Canada	1.2	0.3	1.6	0.1
Mexico to United States	1.8	0.7	1.7	0.3
United States to Mexico	1.2	0.4	1.4	0.0
Canada to Mexico	1.0	0.4	1.4	0.4
Mexico to Canada	0.8	0.4	1.3	-0.2

Note: Values range from -2 (strong negative growth) to +2 (strong positive growth)

Freight Flows DIRECTION	NAFTASTIQUE!	ONE WORLD ORDER	GLOBAL MARKETPLACE	MILLIONS OF MARKETS
Canada to United States	1.8	1.3	1.3	-0.3
United States to Canada	1.5	0.6	0.8	-0.9
Mexico to United States	1.5	1.3	1.7	0.3
United States to Mexico	1.1	0.9	1.0	-0.3
Canada to Mexico	1.1	0.5	0.8	-0.4
Mexico to Canada	1.0	0.0	1.3	-0.05

Note: Values range from -2 (strong negative growth) to +2 (strong positive growth)

In addition, the group discussed how the regional flows of each scenario compared to each other. The results are shown below.

Cross Scenario Comparisons (Regions)

Passenger Flow						Freight Flow				
Region	Naf!	OWO	GMKT	MoM		Region	Naf!	OWO	GMKT	MoM
BC-WA	8%	5%	8%	10%		BC-WA	12%	9%	6%	6%
USA-CAN Central	4%	3%	3%	2%		USA-CAN Central	6%	5%	9%	5%
Great Lakes	16%	11%	9%	5%		Great Lakes	18%	12%	9%	4%
Finger Lakes	8%	4%	2%	5%		Finger Lakes	4%	3%	3%	5%
NB-ME	0%	2%	0%	0%		NB-ME	1%	3%	1%	1%
Cali-Baja	11%	13%	11%	1%		Cali-Baja	3%	5%	8%	1%
USA-MEX Central	5%	9%	6%	0%		USA-MEX Central	8%	7%	7%	1%
TX-MX	13%	13%	13%	0%		TX-MX	11%	7%	7%	0%
Air CAN	7%	2%	8%	19%		Air CAN	1%	1%	2%	6%
Air USA	11%	3%	11%	22%		Air USA	5%	1%	5%	6%
Air MEX	11%	3%	15%	3%		Air MEX	2%	1%	4%	2%
East Coast	N/A	N/A	N/A	N/A		East Coast	6%	11%	9%	7%
Gulf Coast	N/A	N/A	N/A	N/A		Gulf Coast	9%	9%	5%	4%
West Coast	N/A	N/A	N/A	N/A		West Coast	0%	12%	11%	6%
Other	0%	2%	9%	0%		Other	0%	3%	4%	0%
Total (%) =	93%	68%	93%	66%		Total (%) =	88%	89%	89%	53%

E.2.6 Current Investment Needs

The afternoon session ended with the question: what region needs the most investment for passenger and freight flows today? Each participant was allowed one vote for each.

Region	Passenger Flows		Freight Flows	
	Votes	% of Total	Votes	% of Total
BC-WA	1	2.5%	2	5.0%
USA-CAN Central	4	10.0%	3	7.5%
Great Lakes + Finger Lakes	18	45.0%	28	70.0%
NB-ME	0	0.0%	0	0.0%
Cali-Baja	0	0.0%	0	0.0%
USA-MEX Central	5	12.5%	0	0.0%
TX-MX	1	2.5%	3	7.5%
Air CAN	2	5.0%	0	0.0%
Air USA	1	2.5%	0	0.0%
Air MEX	1	2.5%	0	0.0%
East Coast	N/A	N/A	0	0.0%
Gulf Coast	N/A	N/A	0	0.0%
West Coast	N/A	N/A	4	10.0%
Other	0	0.0%	0	0.0%
Total =	**33**	**82.5%**	**40**	**100.0%**

E.3 MEXICO CITY WORKSHOP, MARCH23, 2015

FHWA executed the third of three workshops to support Task 4 of Scenario Planning of Future Freight and Passenger Traffic Flows across Border Regions project on March 23rd, 2015 at the Crowne Plaza hotel in Mexico City.

Over 180 potential participants were invited to participate in the Mexico City workshop. FHWA and SCT distributed invitations. Invitees that did not respond by an initial registration deadline were individually contacted by phone or email to encourage their participation. A total of 63 participants attended the workshop. The majority represented governmental agencies and industry associations.

ORGANIZATION	ATTENDEES	% OF TOTAL
Federal/State Mexican Government	29	46%
Mexican Associations	16	25%
Freight Rail Carriers	3	5%
Air Cargo and/or Passenger Carriers	1	2%
Mail & Parcel, Cargo Carriers - Domestic & International	2	3%
Manufacturers/Exporters	4	6%
Consultants	2	3%
Intercity Passenger Bus Carriers	1	2%
Development Corporations	1	2%
Maritime Services	1	2%
Distribution Centers Developers	1	2%
Third Party Logistics (3PL)	2	3%
Total =	**63**	100%

The workshop began with a welcome and brief introduction, which discussed the overall project and its goals and objectives. After the welcome, there was a brief overview of changes in population, Gross Domestic Product (GDP), and GDP per capita in the U.S., Canada and Mexico from 1995 to 2013, passenger and freight cross-border flows along the U.S.-Canada Border after the NAFTA agreement was signed in 1994, and relevant figures on the U.S.-Canada trade relationship.

The morning session continued with a presentation describing scenario planning and how it is a tool to prepare for the future, not predict it. A short introduction of each NCHRP 750 scenarios (*Naftástique*, *Millions of Markets*, *Global Marketplace*, and *One World Order*) was given, and the participants dispersed into their respective breakout groups.

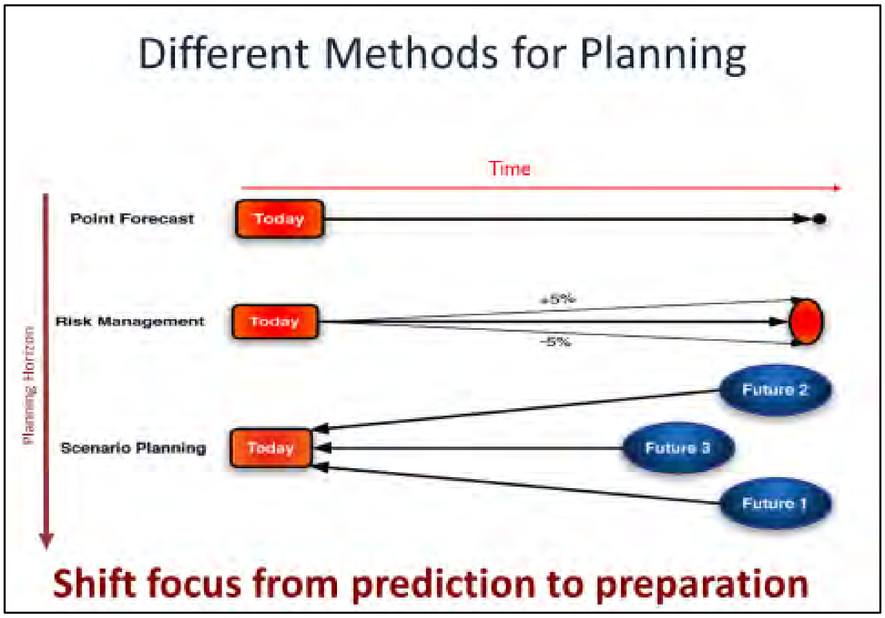


Figure 3: Scenario planning is a tool that can be used to better prepare for an uncertain future.

The attendees were divided into four breakout groups. Each of the breakouts were assigned one scenario and separated into difference conference rooms. Facilitators directed each group to identify the driving forces behind passenger and freight growth given the assigned scenario. In addition, the group undertook an exercise to gauge participants' thoughts on future passenger and freight growth.

Scenario	PARTICIPANTS	Scenario Facilitator
Naftástique	17	Isabel Victoria
One World Order	16	Juan Ramirez
Global Marketplace	15	Claudio Figueroa
Millions of Markets	15	Vicente Mantero
Total =	**63**	

The following includes a brief discussion of each scenario, identified driving forces, and flow exercise results that describe the magnitude and regional flow.

E.3.1. Naftástique!

E.3.1.1 Scenario Characteristics

- Government actions to prioritize meeting of local resource needs have created mostly self-contained blocs across the world. The U.S. is in NAMEC (North American Economic Community).
- People and goods move freely between the United States, Canada, and Mexico. People live, work, and retire anywhere within bloc.
- NAMEC is energy independent - from natural gas (#1 source), coal (close 2nd), and renewable energy (~20% of total energy mix).
- Manufacturing has returned to NAMEC.
    - Economic blocs are strong clusters. Freely flow of goods within blocs but limited between —mainly commodities not available within that bloc
- Currency prices are stable within and across blocs.
- Energy prices are high but stable.
- Society and businesses are environmentally conscious — companies look to reduce waste. Environmental regulations are strong, but are bottom-up (instead of top-down as in One World Order - OWO).
- Political regulations are strong. They have created blocs but seek to facilitate free flow within blocs.

E.3.1.2 Driving Forces to Passenger Growth

- Higher incomes create larger disposable incomes which encourage cross-border personal travel, particular recreational/leisure/vacation trips
- Easing of regulations on travel and immigration among NAMEC nations
- Single NAMEC travel ID card (Global Entry like) facilitates passenger crossings
- Some stakeholders foresee Mexican Immigration to U.S. slows significantly due to better/equitable working conditions and opportunities in Mexico
- Improved travel time crossings/reliability for personal travel at the borders
- Harmonized/streamlined labor regulations among NAMEC members create a unique labor market within the bloc with comparable skill-sets and better/more equitable wages and benefits that moves freely between the U.S., Mexico and Canada
- More multicultural population within NAMEC
- Increase in the number of bilingual people (English and Spanish, mainly) promotes personal travel, especially between Mexico and the U.S. and Mexico and Canada.
- Other regional flows - Passenger train services crossing the U.S.-Mexico border at east, central and west land ports of entry (LPOs)

E.3.1.3 Driving Forces to Freight Growth

- Re-domestication of manufacturing to North America increases manufacturing trade flows between NAMEC members, specially electronics, autos/auto-parts, aerospace and medical products
- Positive trend of near-shoring (movement of manufacturing from Asia to the U.S., Mexico and Canada) increases freight flows of manufacturing products, particularly northbound/southbound freight movements and eastbound/westbound freight movements

- Easy trade among the U.S., Mexico and Canada due to harmonized regulations for border crossings (i.e., Customs integration among NAMEC countries) for all available transportation modes
- Significant increase of agricultural output in Canada impacts agricultural products trade patterns (e.g., agricultural products tonnage trade between Mexico and the U.S., origin-destination patterns, etc.)
- Accelerated adoption of new information technologies/communication allow companies to outsource their operations within the bloc to take advantage of raw material supplies, high-skill labor markers, and access to markets, wherever these resources present the greatest competitive advantage.
- Advanced information technologies support electronic documentation and facilitate multimodal transportation among NAMEC countries
- Improved infrastructure, information technologies and communications result in seamless integration among transportation modes and therefore, increase multimodal services for the movement of cargo across the U.S./Mexico and U.S./Canada borders
- Stable and transparent tariff regime for trade (imported and exported) goods in the NAMEC nations
- Remove of trade barriers causes NAMEC nations' currency to appreciate
- Logistics clusters connected by seamless multimodal corridors that transverse the three NAMEC nations and provide value-added services
- Advanced security and risk analysis for cargo movements across the border regions
- Since the largest growth in U.S. population has happened in the Mountain region, mainly in Arizona, Colorado, Nevada and New Mexico, Mexican exports entering the U.S. through Arizona ports of entry (POEs) experience a significant increase, especially Mexican agricultural products.
- Greater intra-regional trade will increase cross-border sourcing and thus freight movements
- Limited NAMEC trade with other economic blocs
- Some stakeholders foresee a decrease in crude oil trade between NAMEC members because of the significant increase of energy production in North America from sources others than petroleum products (e.g., natural gas, solar, wind energy, and clean coal technology),
- Other stakeholders foresee the following energy trade trends: (1) increase in oil and natural gas trade from U.S. to Mexico/Canada, and (2) increase in solar energy trade from Mexico to U.S./Canada.
- Water cargo becomes more competitive and therefore, maritime trade among Mexican and U.S. seaports located in the Gulf Coast increases, particularly oil, petroleum products, and natural gas trade

E.3.1.4 Future Flows

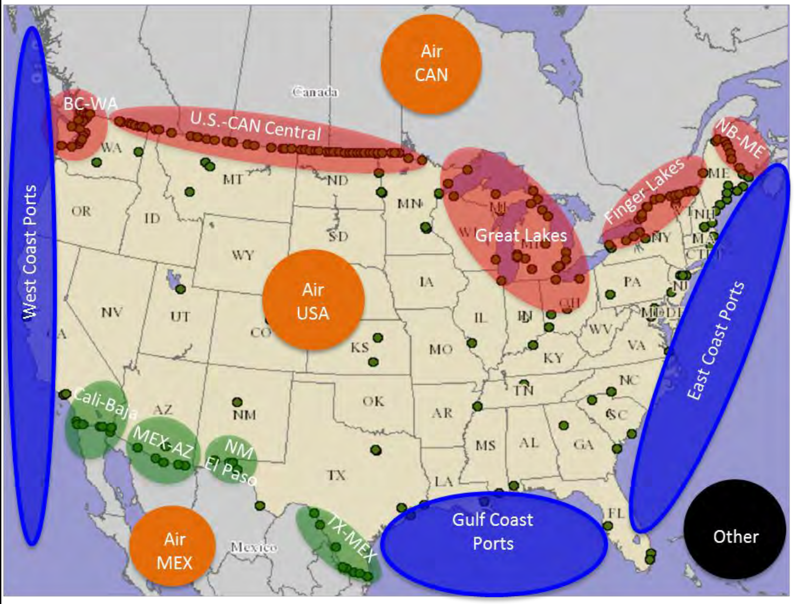
The group undertook an exercise to gauge how they thought the scenario would impact future flows by direction. The results shown here are normalized to represent 0 as no change from today and range from +2 as strong positive growth and -2 as strong negative growth.

Naftástique! – Flows		
DIRECTION	PASSENGER	FREIGHT
Canada to United States	0.53	0.76
United States to Canada	0.41	0.71
Mexico to United States	1.00	1.35
United States to Mexico	1.41	1.53
Canada to Mexico	0.53	0.76
Mexico to Canada	1.00	0.71

Note: Values range from -2 (strong negative growth) to +2 (strong positive growth)

Similarly, the group was asked to define where the growth would take place for passenger and freight flows. Each participant was given 12 points for passenger and 15 points for freight to allocate across the regions displayed on the map, for a total of 120 points for passenger and 150 points for freight. The freight allocation was increased by 3 points to account for three additional regions that were particular to freight movement. Participants could place all their points in one region, or spread them out across the regions in any fashion. For passenger flows, 90 percent of the total points were allocated across the regions where personal travel is expected to increase. For freight flows, 85 percent of the total points were allocated across the regions where cargo movements are expected to increase.

Regional Flows



Region	% PAX	% Freight
BC-WA	0%	0%
USA-CAN Central	10%	4%
Great Lakes	4%	3%
EE.UU.-CAN Este	4%	3%
Cali-Baja	11%	10%
MEX-AZ	7%	6%
NM El Paso	3%	4%
TX-MX	21%	22%
Air CAN	3%	2%
Air USA	12%	5%
Air MEX	12%	6%
East Coast		3%
Gulf Coast		11%
West Coast		5%
Other	0%	0%
Total (%) =	90%	85%

E.3.2 One World Order

E.3.2.1 Scenario Characteristics

- Vital resources — energy, water, minerals, etc. — are scarce.
- Governments have created the World Sustainable Trade Organization (WSTO). It has both reach and teeth and is seen as crucial in keeping order and peace.
- Global trade has transformed, from chaotic market-based globalization to an ordered, less volatile and more predictable process.
- Although the invisible hand of the market still decides 'what' and 'where' to produce, it is the visible hand of regulation that dictates the 'how'.
- Firms have adapted to a highly regulated environment.
- The objective of the WSTO regulations is to achieve a long-term global solution, not short-term firm profits.
- Most governments lobby the WSTO heavily to sway the regulations to favor their own resources and requirements.
- Government agencies at all levels (federal, state, local) have enacted regulations on emissions, sewage, recycling, garbage, and most other aspects. Cities grow bigger, yet the per-capita environmental impact decreases.
- Government discourages the home delivery of small/cheap packages through taxes and fees.
- Consolidation centers emerge in cities, to aggregate deliveries.
- Manufacturers have created large-scale production clusters and ultra-efficient supply chains.

E.3.2.2 Driving Forces to Passenger Growth

- Immigration reform
- Ease to cross borders without penalty
- Tourism
- Necessity or non-necessity to travel
- Education of society - in other words, a higher population of people would be highly educated or informed in this scenario
- Other regional flows from Cancun International Airport

E.3.2.3 Driving Forces to Freight Growth

- Social media/digital world
- Online purchases from comfort of your own home
- Trade among neighboring regions or blocks of regions, instead of international global trade (i.e. trade among megacities)
- Collaboration between regions, such as the sharing of natural resources (e.g., petroleum, minerals, energy, shale, etc.) due to their scarcity
- Importance of Cancun as a major freight location/gateway
- Other regional flows from Port of Cancun

E.3.2.4Future Flows

The group undertook an exercise to gauge how they thought the scenario would impact future flows by direction. The results shown here are normalized to represent 0 as no change from today and range from +2 as strong positive growth and -2 as strong negative growth.

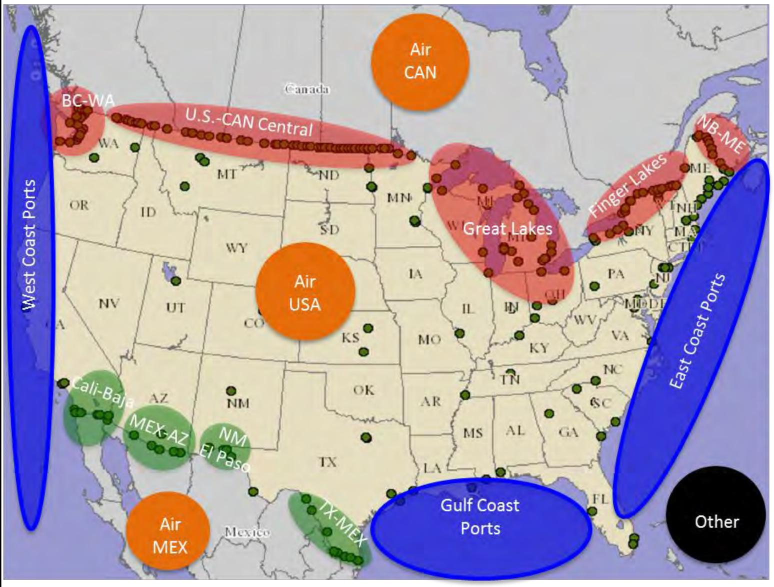
One World Order – Flows		
DIRECTION	PASSENGER	FREIGHT
Canada to United States	0.00	0.13
United States to Canada	-0.06	0.31
Mexico to United States	0.31	0.81
United States to Mexico	0.50	0.81
Canada to Mexico	0.00	0.19
Mexico to Canada	-0.06	0.44

Note: Values range from -2 (strong negative growth) to +2 (strong positive growth)

Similarly, the group was asked to define where the growth would take place for passenger and freight flows. Each participant was given 12 points for passenger and 15 points for freight to allocate across the regions displayed on the map, for a total of 120 points for passenger and 150 points for freight. The freight allocation was increased by 3 points to account for three additional regions that were particular to freight movement. Participants could place all their points in one region, or spread them out across the regions in any fashion. For passenger flows, 73 percent of the total points were allocated across the regions where personal travel is expected to increase. For freight flows, 65 percent of the total points were allocated across the regions where cargo movements are expected to increase.

Regional Flows

ONE WORLD ORDER



Region	% PAX	% Freight
BC-WA	1%	0%
USA-CAN Central	2%	5%
Great Lakes	1%	1%
EE.UU.-CAN Este	3%	1%
Cali-Baja	11%	6%
MEX-AZ	9%	5%
NM El Paso	8%	7%
TX-MX	16%	12%
Air CAN	2%	1%
Air USA	8%	3%
Air MEX	8%	5%
East Coast		8%
Gulf Coast		7%
West Coast		4%
Other	4%	1%
Total (%) =	73%	65%

E.3.3 Global Marketplace

E.3.3.1Scenario Characteristics

- Significant global trade that involves most countries — high level of collaboration across nations.
- Very high volatility in the supply of goods, currency values, and commodity prices.
- High level of virtual trade (intellectual property).
- Supply chains are very versatile yet reasonable in cost.
- Energy is cheap and available, yet the prices are highly volatile.
- Distributed global manufacturing footprint for most large companies.
- People prefer to live in large and dense cities — mega-cities are fast growing.
- Global companies achieve and leverage economies of scale.
- Governmental regulations exist mainly to support global trade.

E.3.3.2`Driving Forces to Passenger Growth

- Main cross-border trip purposes are business, education or tourism
- Companies or countries looking for talents for specialized labor
- Increase in passenger traveling from Mexico to the U.S. due a thinning border and less expensive trips
- Increase in passenger flows from Juarez-Chihuahua to Arizona border
- Other regional flows - A significant increase of personal travel between Chihuahua and Arizona and new land ports of entry (LPOEs) along Arizona-Chihuahua border region serving the additional passenger cross-border flows.

E.3.3.3 Driving Forces to Freight Growth

- The shortest distance would prevail, either by ground, air or maritime transportation
- Increase in transportation infrastructures due to government trying to ease the freight movement
- Shift in specialization due to the globalization, like the automotive sector where they expect Mexico to produce more vehicles than in the U.S.
- Other regional flows - Increase in freight handled by existing and new Pacific Mexican ports to leverage the inability of the U.S. West Coast ports to deal with the growing traffic between Asia and North America.

E.3.3.4 Future Flows

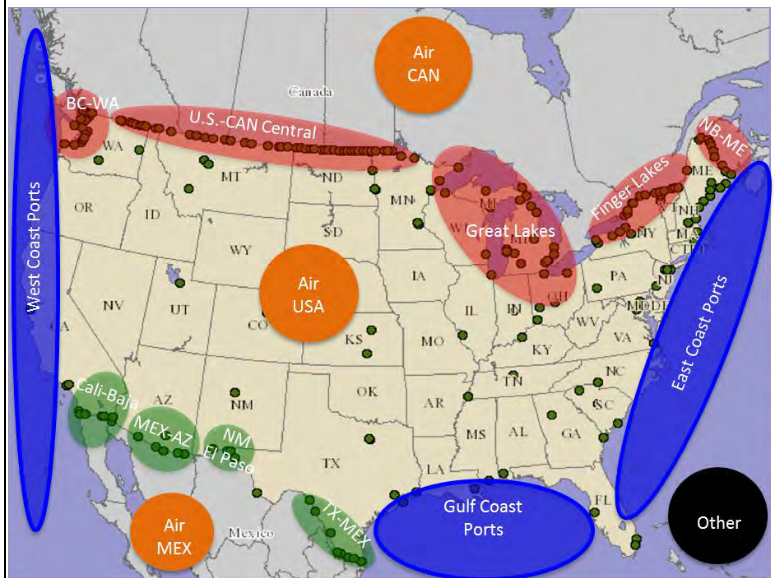
The group undertook an exercise to gauge how they thought the scenario would impact future flows by direction and mode. The results shown here are normalized to represent 0 as no change from today and range from +2 as strong positive growth and -2 as strong negative growth.

Global Marketplace – Flows		
DIRECTION	PASSENGER	FREIGHT
Canada to United States	0.93	1.07
United States to Canada	1.00	1.00
Mexico to United States	0.80	1.67
United States to Mexico	1.60	1.87
Canada to Mexico	0.33	0.73
Mexico to Canada	0.87	1.07

Note: Values range from -2 (strong negative growth) to +2 (strong positive growth)

Similarly, the group was asked to define where the growth would take place for passenger and freight flows. Each participant was given 12 points for passenger and 15 points for freight to allocate across the regions displayed on the map, for a total of 120 points for passenger and 150 points for freight. The freight allocation was increased by 3 points to account for three additional regions that were particular to freight movement. Participants could place all their points in one region, or spread them out across the regions in any fashion. For passenger flows, 100 percent of the total points were allocated across the regions where personal travel is expected to increase. For freight flows, 95 percent of the total points were allocated across the regions where cargo movements are expected to increase.

Regional Flows



Region	% PAX	% Freight
BC-WA	4%	2%
USA-CAN Central	3%	3%
Great Lakes	3%	1%
EE.UU.-CAN Este	7%	2%
Cali-Baja	19%	8%
MEX-AZ	8%	6%
NM El Paso	9%	8%
TX-MX	14%	15%
Air CAN	9%	4%
Air USA	9%	5%
Air MEX	13%	8%
East Coast		8%
Gulf Coast		6%
West Coast		15%
Other	2%	3%
Total (%) =	100%	95%

E.3.4 Millions of Markets

E.3.4.1 Scenario Characteristics

- The world has transformed into many self-sufficient clusters — countries and regions.
- Population is dispersed. The greatest population growth occurs in mid-sized cities.
- People prefer personalized and customized products.
- The US is energy independent, mainly through natural gas and nuclear energy.
- Technology allows material to be maintained in the raw form until when needed for production (which is done close to the market).
- Intellectual property is in smart materials and technologies that allow postponed production.
- Markets are mostly regional with demand being met by local supply
- Technological innovations have lowered economies of scale so that customized production in small batches is economically sound.
- Supply chains mostly carry undifferentiated/raw material for long distance and differentiated goods for short distance. (Undifferentiated material need not be cheap).
- People reuse & recycle — technology enables better recapture of the raw materials.
- Regulations focus on protecting intellectual property.
- Regional governments compete to make their region more attractive for businesses investment.
- There is a growing "digital divide" between blue collar and no-collar workers

E.3.4.2 Driving Forces to Passenger Growth

- Large number of medium size cities
- Dependent on air travel to get back and forth physically (urban aviation)
- Poverty: Collapse of working class and decreasing rates of retirement
- Lack of migration between Mexico and the U.S. because of small amount of laborers/workers required
- Ease of regulations will make it easier to travel, back and forth. However, aside from social and leisure travel, not much work or job-related travel.
- Perception of traveling by air will change. Currently seen as high cost, convenient mainly for high-income earners. Air travel will be more affordable, and commonplace, in the future.
- Passenger rail will not be a large factor
- Since air will be more prevalent, border movement is still important, but movement between Mexico and interior U.S. will be more common
- Other regional flows - Due to the "millions of markets" and greater number of large and medium-size cities, relatively transparent border, regional flows will not be limited to the border regions. There will be enhanced passenger service between Mexico and "inland regions", especially high-tech centers, such as Dallas/Fort Worth (DFW), Houston, San Francisco, Oklahoma City, etc. While air will be predominant, there will be increased roadway and passenger rail service to these inland "hi-tech" regions, especially from Mexico.

E.3.4.3 Driving Forces to Freight Growth

- Little regulations (except intellectual rights)
- Open borders
- Close proximity of industrial sectors to cities

- Long distance of raw materials only
- Automation and technology driving innovation and production
- Local demand driving production, especially personalized products
- Customized production in small batches driving a consumer-driven market
- Services more important to economy than products
- U.S. is energy independent, so energy flows by pipeline, maritime, etc., between Mexico and U.S. stop
- Supply chain has changed dramatically. Traditional model has changed, with distribution centers/warehouses in smaller scale and more dispersed next to regional centers.
- Still a reliance on trucks because of localized demand
- Aside from raw materials, little cargo/freight ground movement between Mexico and U.S. borders
- Other regional flows - Due to the “millions of markets” and local production increases, the traditional supply chain distribution center model has shifted. Raw materials are moving directly into regions, rather than previously processed in a distribution/consolidation center near the border. With a more transparent border, raw materials, especially heavy goods that do not move by air will move directly by train or truck from Mexico to regional centers in the U.S., as demand dictates. This includes major metro regions, such as DFW, Chicago, Phoenix, etc. While much of this will enter through the marine ports on the coasts, there will be a stronger demand for raw materials traveling by surface modes (rail and truck) to inland U.S. metro regions.

E.3.4.4 Future Flows

The group undertook an exercise to gauge how they thought the scenario would impact future flows by direction. The results shown here are normalized to represent 0 as no change from today and range from +2 as strong positive growth and -2 as strong negative growth.

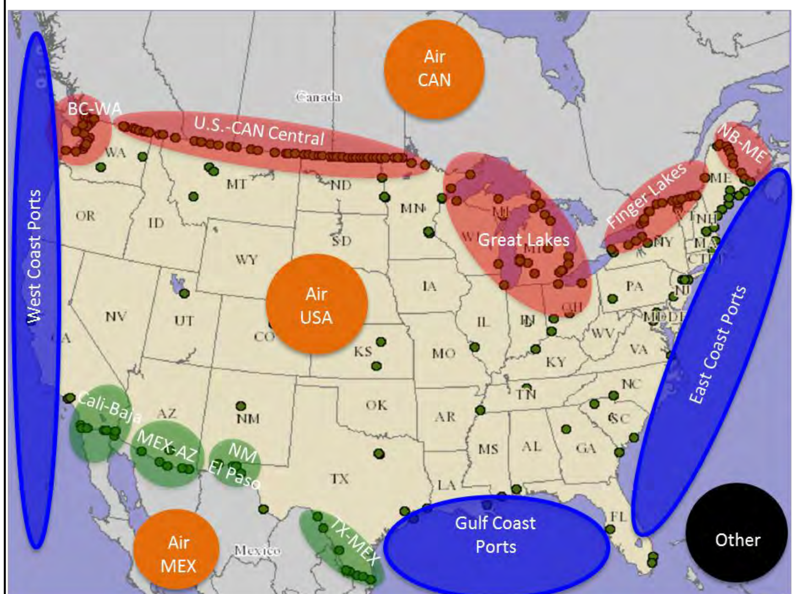
Millions of Markets – Flows		
DIRECTION	PASSENGER	FREIGHT
Canada to United States	0.40	-0.27
United States to Canada	0.33	-0.27
Mexico to United States	0.40	0.20
United States to Mexico	-0.20	1.13
Canada to Mexico	0.80	-0.27
Mexico to Canada	0.87	0.53

Note: Values range from -2 (strong negative growth) to +2 (strong positive growth)

Similarly, the group was asked to define where the growth would take place for passenger and freight flows. Each participant was given 12 points for passenger and 15 points for freight to allocate across the regions displayed on the map, for a total of 120 points for passenger and 150 points for freight. The freight allocation was increased by 3 points to account for three additional regions that were particular to freight movement. Participants could place all their points in one region, or spread them out across the regions in any fashion. For passenger flows, 87 percent of the total points were allocated across the regions where personal travel is expected to increase. For freight flows, 80 percent of the total points were allocated across the regions where cargo movements are expected to increase.

Regional Flows

MILLIONS OF MARKETS



Region	% PAX	% Freight
BC-WA	1%	0%
USA-CAN Central	4%	1%
Great Lakes	5%	1%
EE.UU.-CAN Este	6%	4%
Cali-Baja	10%	3%
MEX-AZ	3%	5%
NM El Paso	3%	2%
TX-MX	9%	8%
Air CAN	11%	6%
Air USA	15%	11%
Air MEX	19%	8%
East Coast		12%
Gulf Coast		8%
West Coast		9%
Other	3%	2%
Total (%) =	87%	80%

E.3.5 Conclusions

The afternoon discussion centered on comparing the four scenario flow exercises. This discussion included each breakout group presenting the driving forces described above, followed by a presentation that showed how each scenario's flow exercise compared to each other. Similar to the other flow charts in this document, results shown here are normalized to represent 0 as no change from today and range from +2 as strong positive growth and -2 as strong negative growth.

Passenger Flows DIRECTION	NAFTASTIQUE!	ONE WORLD ORDER	GLOBAL MARKETPLACE	MILLIONS OF MARKETS
Canada to United States	0.5	0.0	0.9	0.4
United States to Canada	0.4	-0.1	1.0	0.3
Mexico to United States	1.0	0.3	0.8	0.4
United States to Mexico	1.4	0.5	1.6	-0.2
Canada to Mexico	0.5	0.0	0.3	0.8
Mexico to Canada	1.0	-0.1	0.9	0.9

Note: Values range from -2 (strong negative growth) to +2 (strong positive growth

Freight Flows DIRECTION	NAFTASTIQUE!	ONE WORLD ORDER	GLOBAL MARKETPLACE	MILLIONS OF MARKETS
Canada to United States	0.8	0.1	1.1	-0.3
United States to Canada	0.7	0.3	1.0	-0.3
Mexico to United States	1.4	0.8	1.7	0.2
United States to Mexico	1.5	0.8	1.9	1.1
Canada to Mexico	0.8	0.2	0.7	-0.3
Mexico to Canada	0.7	0.4	1.1	0.5

Note: Values range from -2 (strong negative growth) to +2 (strong positive growth)

In addition, the group discussed how the regional flows of each scenario compared to each other. The results are shown below.

Cross Scenario Comparisons (Regions)

Passenger Flow

Region	Naf!	OWO	GMKT	MoM
BC-WA	0%	1%	4%	1%
USA-CAN Central	10%	2%	3%	4%
Great Lakes	4%	1%	3%	5%
USA-CAN Este	4%	3%	7%	6%
Cali-Baja	11%	11%	19%	10%
MEX-AZ	7%	9%	8%	3%
NM El Paso	3%	8%	9%	3%
TX-MX	21%	16%	14%	9%
Air CAN	3%	2%	9%	11%
Air USA	12%	8%	9%	15%
Air MEX	12%	8%	13%	19%
East Coast				
Gulf Coast				
West Coast				
Other	0%	4%	2%	3%
Total (%) =	90%	73%	100%	87%

Freight Flow

Region	Naf!	OWO	GMKT	MoM
BC-WA	0%	0%	2%	0%
USA-CAN Central	4%	5%	3%	1%
Great Lakes	3%	1%	1%	1%
Finger Lakes	3%	1%	2%	4%
NB-ME	10%	6%	8%	3%
Cali-Baja	6%	5%	6%	5%
USA-MEX Central	4%	7%	8%	2%
TX-MX	22%	12%	15%	8%
Air CAN	2%	1%	4%	6%
Air USA	5%	3%	5%	11%
Air MEX	6%	5%	8%	8%
East Coast	3%	8%	8%	12%
Gulf Coast	11%	7%	6%	8%
West Coast	5%	4%	15%	9%
Other	0%	1%	3%	2%
Total (%) =	85%	65%	95%	80%

E.3.6 Current Investment Needs

The afternoon session ended with the question: what region needs the most investment for passenger and freight flows today? Each participant was allowed one vote for each.

	Passenger Flows		Freight Flows	
Region	**Votes**	**% of Total**	**Votes**	**% of Total**
BC-WA	0	0%	0	0%
USA-CAN Central	0	0%	0	0%
Great Lakes	0	0%	0	0%
EE.UU.-CAN Este	0	0%	0	0%
Cali-Baja	11	17%	1	2%
MEX-AZ	1	2%	0	0%
NM El Paso	0	0%	1	2%
TX-MX	9	14%	20	32%
Air CAN	0	0%	0	0%
Air USA	0	0%	0	0%
Air MEX	13	21%	0	0%
East Coast	N/A	N/A	0	0%
Gulf Coast	N/A	N/A	4	6%
West Coast	N/A	N/A	8	13%
Other	0	0%	0	0%
Total =	**34**	**54%**	**34**	**54%**

F. FALL 2015 WEBINAR

Please see attached Power Point file

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Contract Number: DTFH61-11-D-00017/5009

Stakeholders Meeting

Task: Scenario Planning of Future Freight and Passenger Traffic Flows Across the U.S./Mexico and U.S./Canada Borders

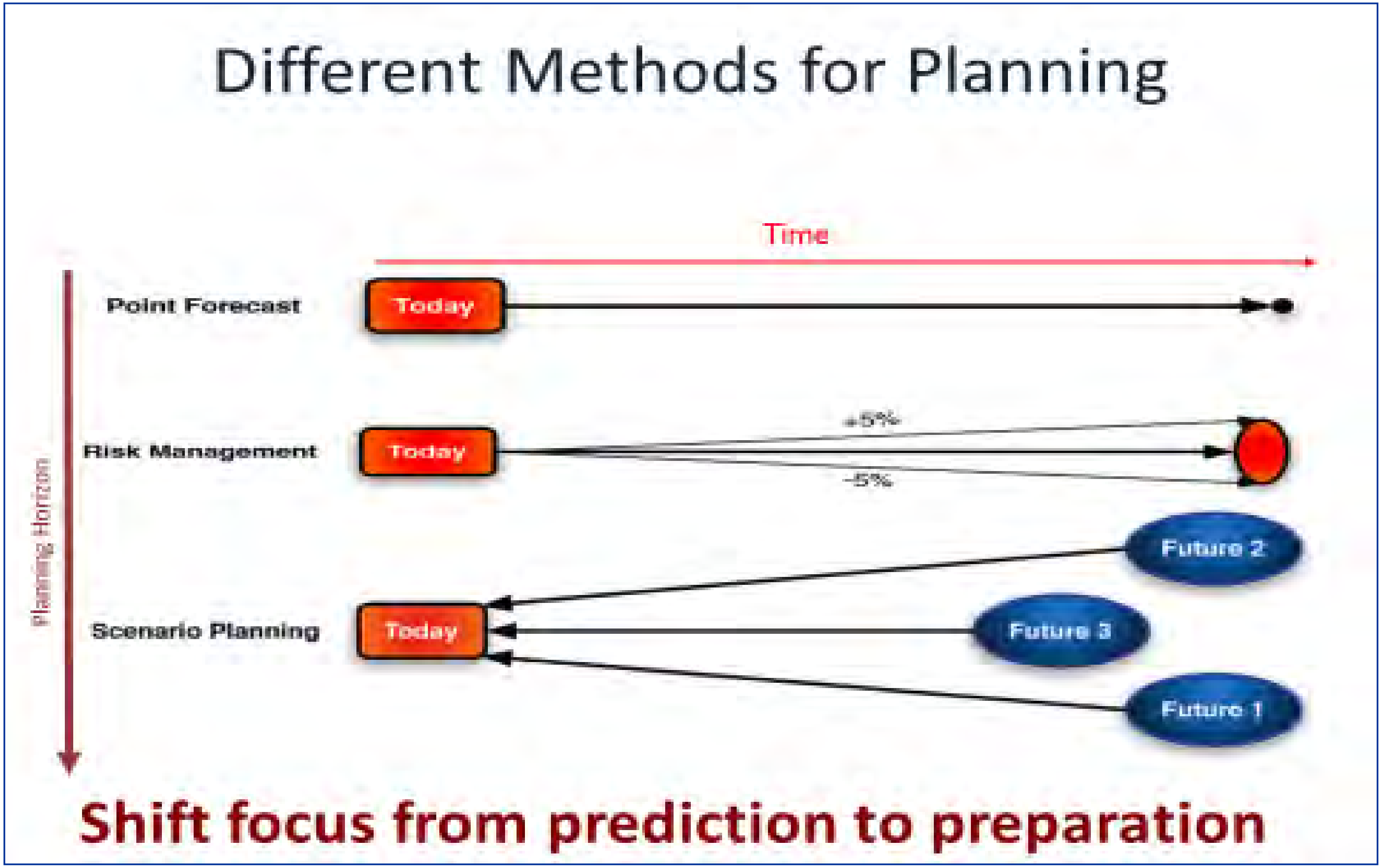
April 28th, 2015

1:00 PM – 2:00 PM (ET)

Meeting Agenda

- Introductions
- First round of workshops on Scenario Development and Analysis for North American Transportation
  - Workshop objectives
  - Workshop participants
  - Structure of the workshops
  - Results
- Next steps

Scenario Forecast



First Round of Workshops

Overarching Goals

- To validate the use of the NCHRP Report 750 four future scenarios (***Naftástique!***, ***One World Order***, ***Global Marketplace***, *and* ***Millions of Markets***) in understanding range of potential futures
- To uncover insights into underlying drivers of passenger and freight cross-border flows from a regional (bi-national) border perspective
- To get initial insights into direction and magnitude of passenger and freight directional flows and regional movements between the three North American countries
- To identify infrastructure needs

First Round of Workshops

Workshop Attendees

Workshop	Invitees	Attendees	Attendance Rate
Feb 24th Workshop with U.S. Stakeholders	300	34	11%
March 11th Workshop with Canadian Stakeholders	250	40	16%
March 25th Workshop with Mexican Stakeholders	180	63	35%
Overall =	**730**	**137**	**19%**

	Participants	%
Participants from the U.S.	35	26%
Participants from Canada	39	28%
Participants from Mexico	63	46%
Overall =	**137**	**100%**

First Round of Workshops

Participant Categories

Washington DC Participant Category	Attendees	%
U.S. Government	19	56%
U.S./Binational Association	7	21%
U.S. Chamber	2	6%
Air Cargo/Passenger Carrier	2	6%
Freight Rail Carrier	1	3%
Intercity Passenger Motor Carrier	1	3%
Developers/Real Estate	1	3%
Consultant	1	3%
Total =	**34**	**100%**

Ottawa Participant Category	Attendees	%
Canadian Government/Provinces	18	45%
Canadian/Binational Association	11	28%
Bridge Authority	5	13%
Freight Rail Carrier	2	5%
U.S. Government	1	3%
Chamber of Marine Commerce	1	3%
Trade Corridor	1	3%
Academia	1	3%
Total =	**40**	**100%**

Mexico City Participant Category	Attendees	%
Federal/State Mexican Government	29	46%
Mexican Association	16	25%
Manufacturer/Exporter	4	6%
Freight Rail Carrier	3	5%
Mail & Parcel, Cargo Carrier - Domestic & Int.	2	3%
Third Party Logistics (3PL)	2	3%
Consultant	2	3%
Air Cargo and/or Passenger Carrier	1	2%
Intercity Passenger Motor Carrier	1	2%
Development Corporation	1	2%
Maritime Services	1	2%
Distribution Centers Developer	1	2%
Total =	**63**	**100%**

First Round of Workshops
National/Binational Associations

U.S./Binational Associations
American Association of Ports Authorities (AAPA)
American Trucking Associations (ATA)
Coalition for America's Gateways and Trade Corridors (CAGTC)
Transportation Intermediaries Association
National Association of Regional Councils (NARC)
American Transportation Research Institute (ATRI)
Canada-U.S. Transportation Border Working Group (TBWG)

Canadian/Binational Associations
Motor Coach Canada (MCC)
Railway Association of Canada (RAC)
Canadian Shipowners Association
St. Lawrence Seaway Management Corporation
Canadian Airports Council (CAC)
Freight Management Association of Canada (FMA)
Southern Ontario Gateway Council (SOGC)
Railway Association of Canada (RAC)
Council of the Great Lakes Region
Canadian Trucking Alliance (CTA)/Ontario Trucking Association

Mexican Associations
Mexican Association of Maritime Agents (AMANAC)
Mexican Automotive Industry Association (AMIA)
Mexican Transport and Mobility Association (AMTM)
National Association of Private Transport (ANTP)
National Chamber of Air Transport (CANAERO)
National Chamber of Trucking (CANACAR)
Confederation of Industrial Chambers of the Mexican United States (CONCAMIN)
Mexican Council of Logistics (CML)
Council of Supply Chain Management Professional Roundtable México (CSCMP)
Mexico National Railroad Association (AMF)
Mexican Chamber of Maritime Transport (CAMEINTRAN)
National Association of Logistics Operators (AOLM)

Workshop Structure

- **Welcome & Attendees' Introductions**
  - Welcome from Susan Kurland, Assistant Secretary for Aviation and International Affairs (**Washington DC)**
  - Welcome from Yuriria Mascott Pérez, Undersecretary of the Secretariat of Communications and Transportation (**Mexico City)**
- **Introduction Session**
  - Scenario planning, as a tool that can be used to shift from forecasting the future to preparing for potential effects
  - Changes in socio-economic conditions, passenger and freight cross-border flows and trade for the NA Region
  - Workshop objectives

Workshop Structure

- **Facilitated Breakout Sessions**
  - Four groups with equal representation of participants
  - Each group was assigned a facilitator and a different future scenario
  - **Scenario Immersion**
  - **Several exercises**
    - Future driving forces of passengers and freight growth
    - Changes in future directional flows
    - Changes in future regional flows
    - Investment needs
- **Debriefing Session**

Facilitated Breakout Sessions
Washington DC

- Open-ended question: **What factors do you think drive or influence cross-border <u>passenger flow</u> in this scenario?**
- Exercise 1

Exercise 1: Passenger Flow Change

How do you think the number of passengers flowing across the borders will change by 2037?

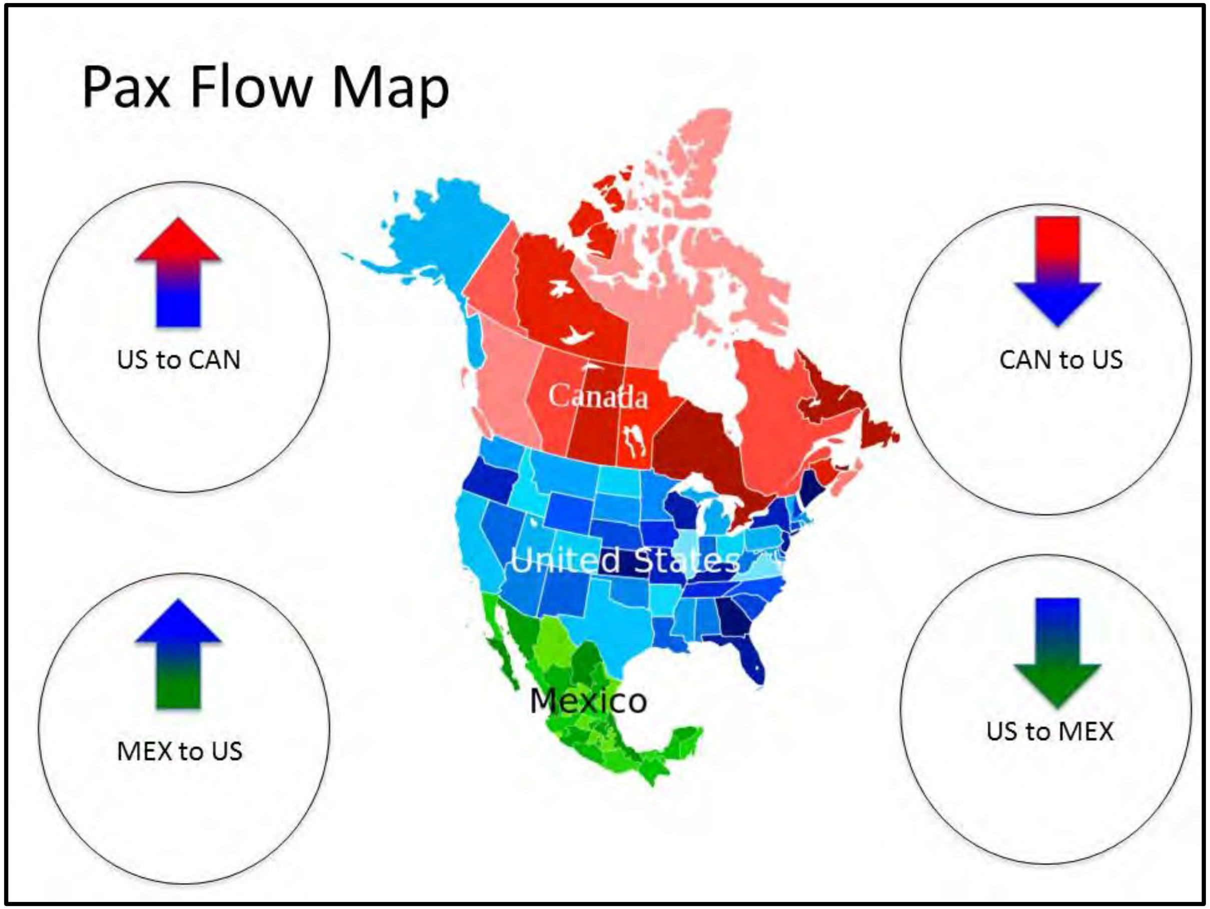
From Canada to the United States	
From The United States to Canada	
From Mexico to the United States	
From the United States to Mexico	

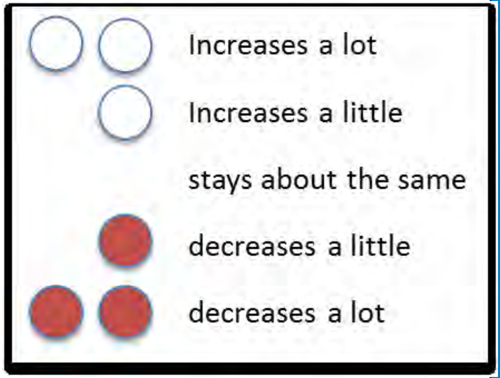
Please enter either a --, -, =, +, or ++ to correspond to:

- = means within +/- 25% of today
- + or – means within a 25% to 50% (increase or decrease) of today, and
- ++ or – –means over 50% (increase or decrease)

Facilitated Breakout Sessions
Washington DC

- Exercise 1





Facilitated Breakout Sessions
Washington DC

- Exercise 2

Exercise 2: Passenger Flow by Mode

How do you think the number of individuals flowing across the borders will change by 2037 by mode?

	Passenger Vehicle	Bus	Trains	Aircraft	Pedestrians
From Canada to the United States					
From The United States to Canada					
From Mexico to the United States					
From the United States to Mexico					

Please enter either a --, -, =, +, or ++ to correspond to:

- = means within +/- 25% of today
- + or – means within a 25% to 50% (increase or decrease) of today, and
- ++ or – –means over 50% (increase or decrease)

Facilitated Breakout Sessions
Washington DC

- Open-ended question: **What factors do you think drive or influence cross-border <u>freight flow</u> in this scenario?**
- Exercise 3

Exercise 3: Freight Flow Change

How do you think the total freight quantity flowing across the borders will change by 2037?

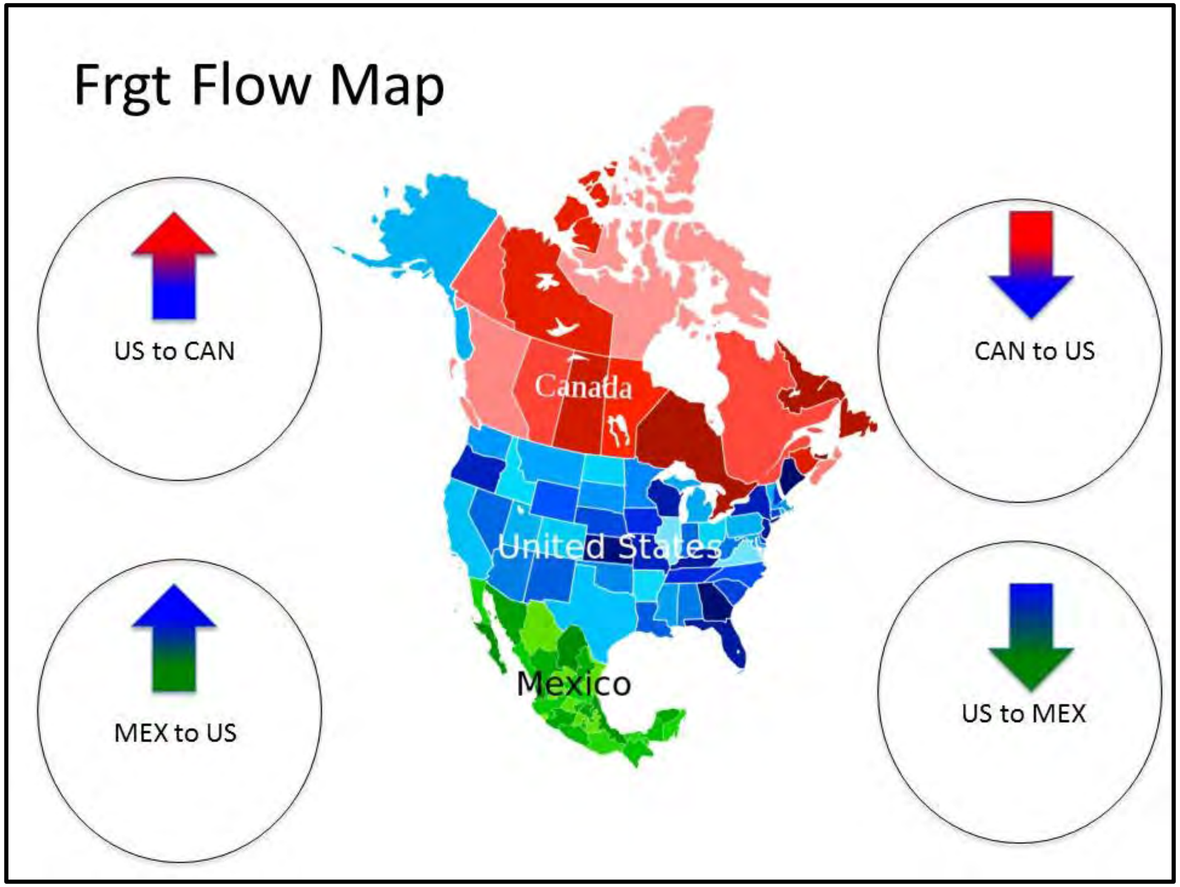
From Canada to the United States	
From The United States to Canada	
From Mexico to the United States	
From the United States to Mexico	

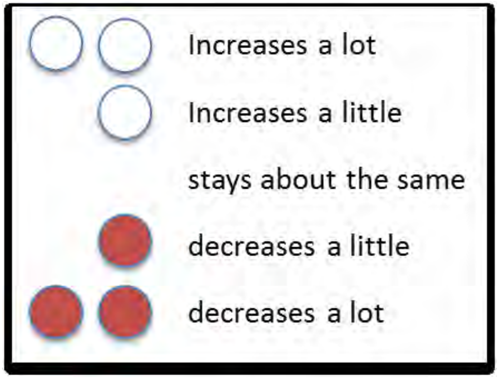
Please enter either a --, -, =, +, or ++ to correspond to:

- = means within +/- 50% of today
- + or – means within a 50% to 100% (increase or decrease) of today, and
- ++ or – – means over 100% (increase or decrease)

Facilitated Breakout Sessions
Washington DC

- Exercise 3





Facilitated Breakout Sessions
Washington DC

- Exercise 4

Exercise 4: Freight Flow by Mode

How do you think the freight flowing across the borders will change by 2037 by mode?

	Truck	Rail	Air	Maritime	Pipeline
From Canada to the United States					
From The United States to Canada					
From Mexico to the United States					
From the United States to Mexico					

Please enter either a --, -, =, +, or ++ to correspond to:

- = means within +/- 50% of today
- + or – means within a 50% to 100% (increase or decrease) of today, and
- ++ or – – means over 100% (increase or decrease)

Facilitated Breakout Sessions

Ottawa & Mexico City

- Open-ended question: **What factors do you think drive or influence cross-border passenger flow in this scenario?**
- Exercise 1: Passenger Flow Change

Exercise 1: Passenger Flow Change

How do you think the number of passengers flowing across the North American borders will change by 2037?

CAN to USA		USA to MEX		CAN to MEX	
USA to CAN		MEX to USA		MEX to CAN	

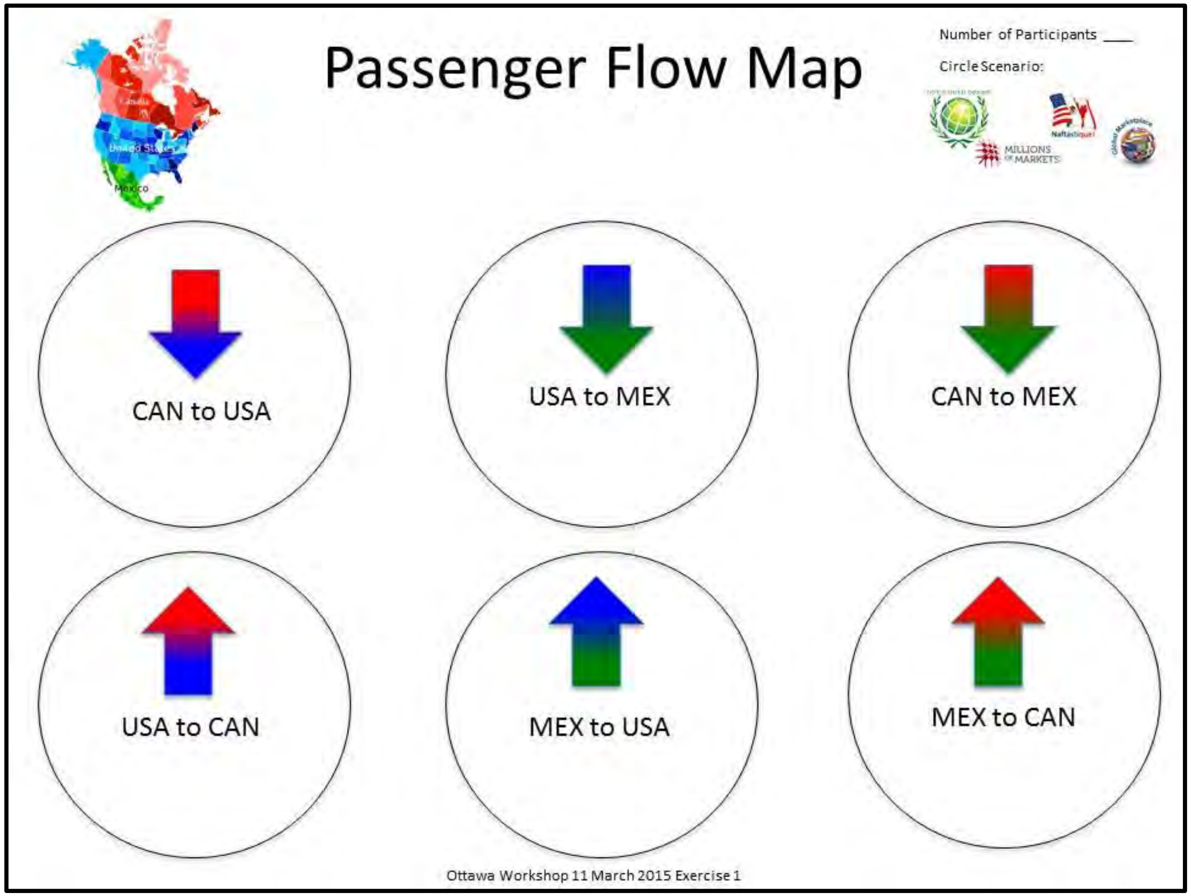
Please enter either a --, -, =, +, or ++ to correspond to:

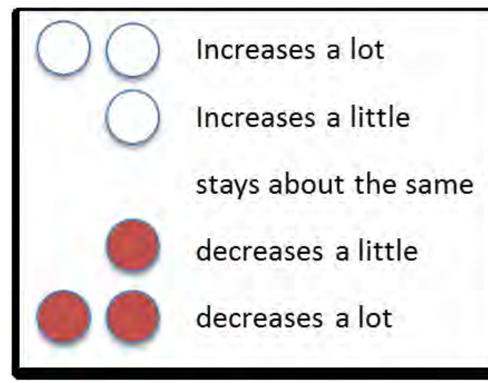
- = means it will not change that much from today
- + or – means a moderate (increase or decrease) from today, and
- ++ or –– means a large (increase or decrease) from today

Facilitated Breakout Sessions

Ottawa & Mexico City

- Exercise 1: Passenger Flow Change





Facilitated Breakout Sessions

Ottawa & Mexico City

- Exercise 2: Passenger Flow by Region

Exercise 2: Passenger Flow by Region

Which regions do you think will have the largest growth in passenger border/gateway crossings by 2037?

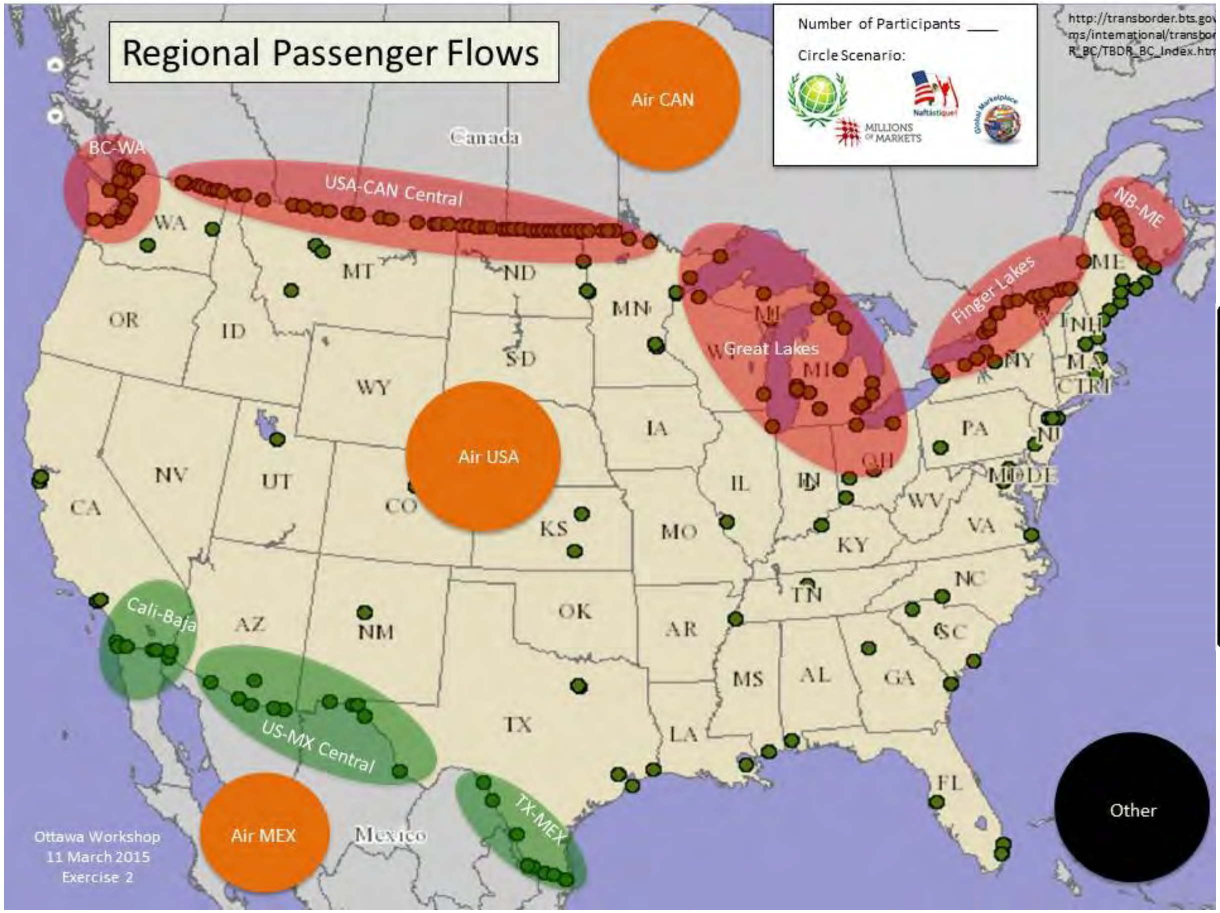
Region	**Points**	**Region**	**Points**
BC-WA		USA-MEX Central	
USA-CAN Central		TX-MX	
Great Lakes		Air CAN	
Finger Lakes		Air USA	
NB-ME		Air MEX	
Cali-Baja		Other	

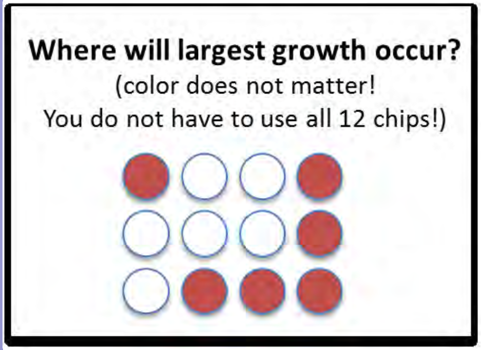
You have 12 points to allocate across these options. You may place them all in one, or spread them out across the regions in any fashion. You do not have to use all of your chips.

Facilitated Breakout Sessions

Ottawa & Mexico City

- Exercise 2: Passenger Flow by Region





Facilitated Breakout Sessions

Ottawa & Mexico City

- Open-ended question: **What factors do you think drive or influence cross-border <u>freight flow</u> in this scenario?**
- Exercise 3: Freight Flow Change

Exercise 3: Freight Flow Change

How do you think the total freight quantity flowing across the borders will change by 2037?

CAN to USA		USA to MEX		CAN to MEX	
USA to CAN		MEX to USA		MEX to CAN	

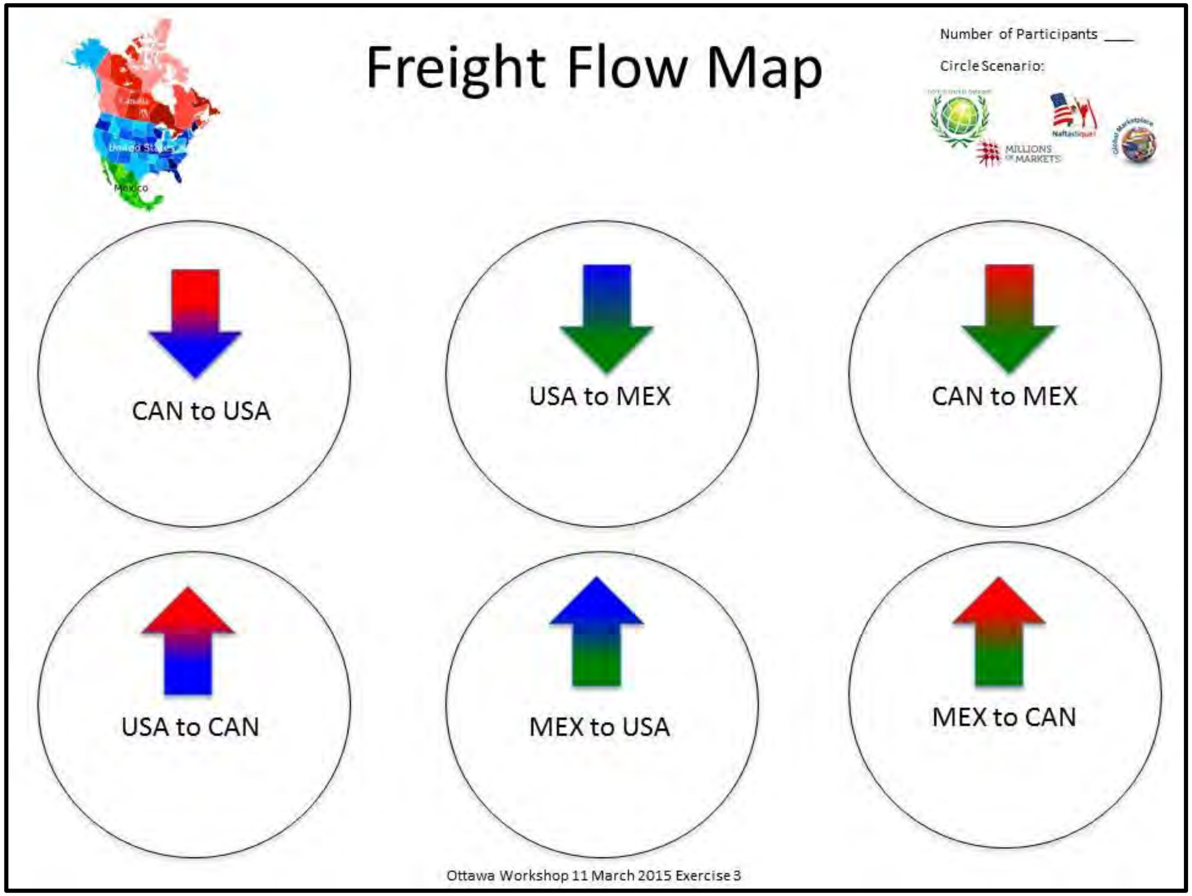
Please enter either a --, -, =, +, or ++ to correspond to:

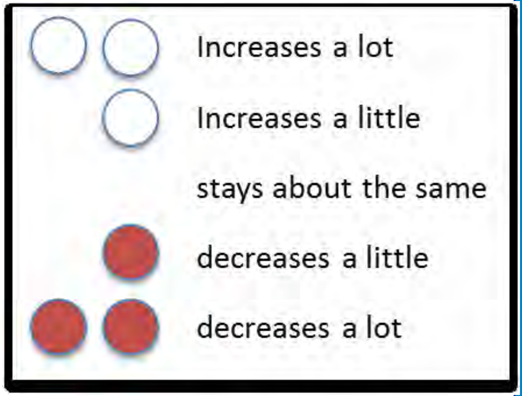
- = means it will not change that much from today
- \+ or – means a moderate (increase or decrease) from today, and
- ++ or –– means a large (increase or decrease) from today

Facilitated Breakout Sessions

Ottawa & Mexico City

- Exercise 3: Freight Flow Change





Workshop Structure
Facilitated Breakout Sessions

- Exercise 4: Freight Flow by Region

Exercise 4: Freight Flow By Region

Which regions do you think will have the largest growth in freight volume border/gateway crossings by 2037?

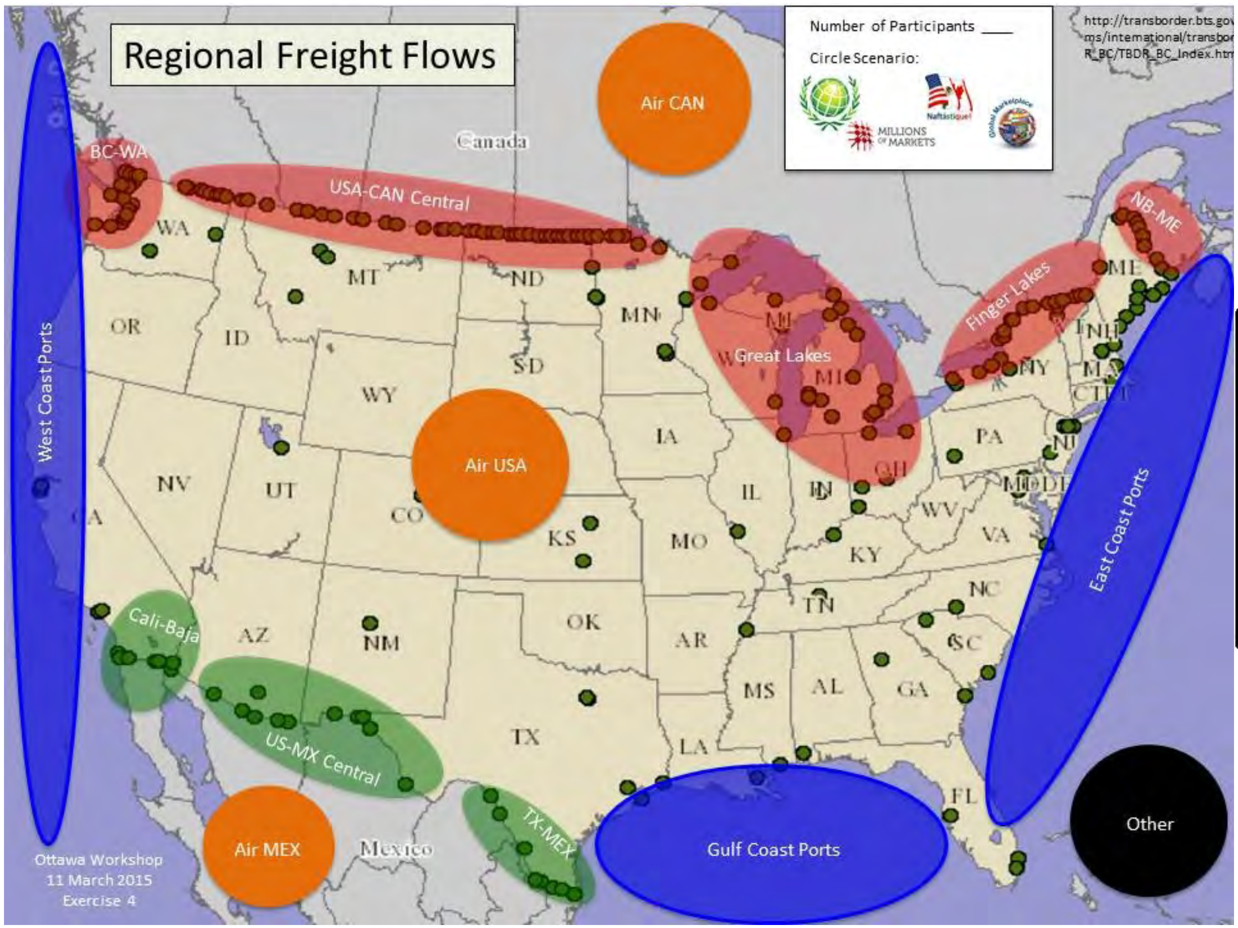
Region	Points	Region	Points
BC-WA		East Coast Ports	
USA-CAN Central		Gulf Coast Ports	
Great Lakes		West Coast Ports	
Finger Lakes		Air CAN	
NB-ME		Air USA	
Cali-Baja		Air MEX	
USA-MEX Central		Other	
TX-MEX			

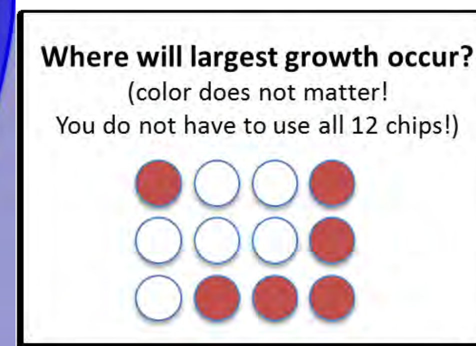
You have 15 points to allocate across these options. You may place them all in one, or spread them out across the regions in any fashion. You do not have to use all of your chips.

Facilitated Breakout Sessions

Ottawa & Mexico City

- Exercise 4: Freight Flow by Region





Facilitated Breakout Sessions Results

- Cross-Workshop Comparison
  - Two open-ended questions:
    - What factors do you think drive or influence cross-border **passenger flow** in this scenario?
    - What factors do you think drive or influence cross-border **freight flow** in this scenario?
  - Exercise 1: Passenger Flow Change
  - Exercise 2: Passenger Flow by Region
  - Exercise 3: Freight Flow Change
  - Exercise 4: Freight Flow by Region

Naftástique!

Open-ended questions: What factors do you think drive or influence cross-border **passenger flow** / **freight flow** in this scenario?

Workshops

Passenger Growth	USA	CAN	MEX
Easing of regulations on travel and immigration between Mexico-U.S.-Canada	✓	✓	✓
Single NAMEC travel ID card (Global Entry like) facilitates passenger crossings		✓	✓
Higher incomes create larger disposable incomes which encourage crossings	✓		✓
Greater interest in travel by visitors, friends and relatives (VFR)	✓	✓	
Improved infrastructure, travel time crossing and reliability for passenger transportation at the borders	✓		✓
Increase in retirement population near borders	✓	✓	
Growth in bilingual population might increase desire for tourism to other areas		✓	✓
Freight Growth	**USA**	**CAN**	**MEX**
Re-domestication of manufacturing to Mexico	✓	✓	✓
Wider adoption of short sea shipping up and down east and west coasts	✓		✓
Increased capacity for freight border crossings	✓		✓
Greater intra-regional trade will increase cross-border sourcing and thus freight moves		✓	✓

One World Order

Open-ended questions: What factors do you think drive or influence cross-border **passenger flow / freight flow** in this scenario?

Workshops

Passenger Growth	USA	CAN	MEX
Rational travel decisions based on price (price will increase substantially)	✓	✓	
Rational travel decisions based on education and awareness (education will increase substantially)			✓
More transit and walking	✓	✓	
Less leisure travel/tourism	✓	✓	✓
Air traffic significantly decreases/Less demand for long distance travel	✓	✓	
Smarted transportation option used (automated vehicles)	✓	✓	
Decrease in entry requirements and regulations			✓
Freight Growth			
Prices of good increase due to scarcity of resources		✓	✓
New rail corridors / Expanded north/south rail network	✓	✓	
Increased production clusters	✓	✓	
Increased collaboration between mega regions			✓
Granting of mutual rights to operate in neighboring state			✓

Global Marketplace

Open-ended questions: What factors do you think drive or influence cross-border **passenger flow / freight flow** in this scenario?

Workshops

Passenger Growth	USA	CAN	MEX
Advanced technology leads to an increased in citizens telecommuting	✓	✓	
Migration between countries for job opportunities/talents for specialized labor	✓	✓	✓
Less expensive trips/increased air travel		✓	✓
Freight Growth			
Increased investments in transportation infrastructure		✓	✓
Increase in use of multiple modes of transportation	✓	✓	
Significant increase in air freight travel	✓	✓	

Millions of Markets

Open-ended questions: What factors do you think drive or influence cross-border **passenger flow / freight flow** in this scenario?

Workshops

Passenger Growth	**USA**	**CAN**	**MEX**
Increase in personal travel for leisure/tourism	✓	✓	✓
Decrease in business travel	✓	✓	✓
Air will be primary mode for personal travel		✓	✓
Decrease in energy cost	✓	✓	
Decrease in cross-border shopping, due to greater online purchasing		✓	✓
Freight Growth			
Decrease of movement of manufactured goods		✓	✓
Pipeline and rail will increase due to raw material demand	✓	✓	
Panama Canal expansion will create new demands for East/Gulf Coast Ports	✓	✓	

Naftástique!

Exercises 1 & 3: Passenger Flow Change / Freight Flow Change

Future Passenger Flows	Cross Workshop Comparison (Values)			Range	
	Washington DC	Ottawa	Mexico City	Lower Value	Upper Value
Canada to United States	0.90	1.50	0.53	0.53	1.50
United States to Canada	0.67	1.20	0.41	0.41	1.20
Mexico to United States	1.25	1.20	1.00	1.00	1.25
United States to Mexico	1.00	1.80	1.41	1.00	1.80
Canada to Mexico	NA	1.00	0.53	0.53	1.00
Mexico to Canada	NA	0.80	1.00	0.80	1.00

Future Freight Flows	Cross Workshop Comparison (Values)			Range	
	Washington DC	Ottawa	Mexico City	Lower Value	Upper Value
Canada to United States	1.30	1.80	0.76	0.76	1.80
United States to Canada	1.20	1.50	0.71	0.71	1.50
Mexico to United States	1.70	1.10	1.35	1.10	1.70
United States to Mexico	1.10	1.50	1.53	1.10	1.53
Canada to Mexico	NA	1.10	0.76	0.76	1.10
Mexico to Canada	NA	1.00	0.71	0.71	1.00

Note: Values range from -2 (strong negative growth) to +2 (strong positive growth)

One World Order

Exercises 1 & 3: Passenger Flow Change / Freight Flow Change

Future Passenger Flows	Cross Workshop Comparison (Values)			Range	
	Washington DC	Ottawa	Mexico City	Lower Value	Upper Value
Canada to United States	-0.30	0.30	0.00	-0.30	0.30
United States to Canada	0.65	0.30	-0.06	-0.06	0.65
Mexico to United States	0.85	0.40	0.31	0.31	0.85
United States to Mexico	-0.80	0.70	0.50	-0.80	0.70
Canada to Mexico	NA	0.40	0.00	0.00	0.40
Mexico to Canada	NA	0.40	-0.06	-0.06	0.40

Future Freight Flows	Cross Workshop Comparison (Values)			Range	
	Washington DC	Ottawa	Mexico City	Lower Value	Upper Value
Canada to United States	0.55	1.30	0.13	0.13	1.30
United States to Canada	0.35	0.60	0.31	0.31	0.60
Mexico to United States	0.45	0.90	0.81	0.45	0.90
United States to Mexico	0.55	1.30	0.81	0.55	1.30
Canada to Mexico	NA	0.50	0.19	0.19	0.50
Mexico to Canada	NA	0.00	0.44	0.00	0.44

Note: Values range from -2 (strong negative growth) to +2 (strong positive growth)

Global Marketplace

Exercises 1 & 3: Passenger Flow Change / Freight Flow Change

Future Passenger Flows	Cross Workshop Comparison (Values)			Range	
	Washington DC	Ottawa	Mexico City	Lower Value	Upper Value
Canada to United States	0.38	1.00	0.93	0.38	1.00
United States to Canada	0.25	1.60	1.00	0.25	1.60
Mexico to United States	1.25	1.40	0.80	0.80	1.40
United States to Mexico	0.70	1.70	1.60	0.70	1.70
Canada to Mexico	NA	1.40	0.33	0.33	1.40
Mexico to Canada	NA	1.30	0.87	0.87	1.30

Future Freight Flows	Cross Workshop Comparison (Values)			Range	
	Washington DC	Ottawa	Mexico City	Lower Value	Upper Value
Canada to United States	0.49	1.30	1.07	0.49	1.30
United States to Canada	0.63	0.80	1.00	0.63	1.00
Mexico to United States	1.40	1.00	1.67	1.00	1.67
United States to Mexico	1.30	1.70	1.87	1.30	1.87
Canada to Mexico	NA	0.80	0.73	0.73	0.80
Mexico to Canada	NA	1.30	1.07	1.07	1.30

Note: Values range from -2 (strong negative growth) to +2 (strong positive growth)

Millions of Markets

Exercises 1 & 3: Passenger Flow Change / Freight Flow Change

Future Passenger Flows	Cross Workshop Comparison (Values)		
	Washington DC	Ottawa	Mexico City
Canada to United States	0.18	0.20	0.40
United States to Canada	-0.09	0.10	0.33
Mexico to United States	0.64	0.00	0.40
United States to Mexico	1.00	0.30	-0.20
Canada to Mexico	NA	0.40	0.80
Mexico to Canada	NA	-0.20	0.87

Range	
Lower Value	Upper Value
0.18	0.40
-0.09	0.33
0.00	0.64
-0.20	1.00
0.40	0.80
-0.20	0.87

Future Freight Flows	Cross Workshop Comparison (Values)		
	Washington DC	Ottawa	Mexico City
Canada to United States	0.36	-0.30	-0.27
United States to Canada	0.63	-0.90	-0.27
Mexico to United States	0.64	-0.30	0.20
United States to Mexico	0.72	0.30	1.13
Canada to Mexico	NA	-0.40	-0.27
Mexico to Canada	NA	-0.50	0.53

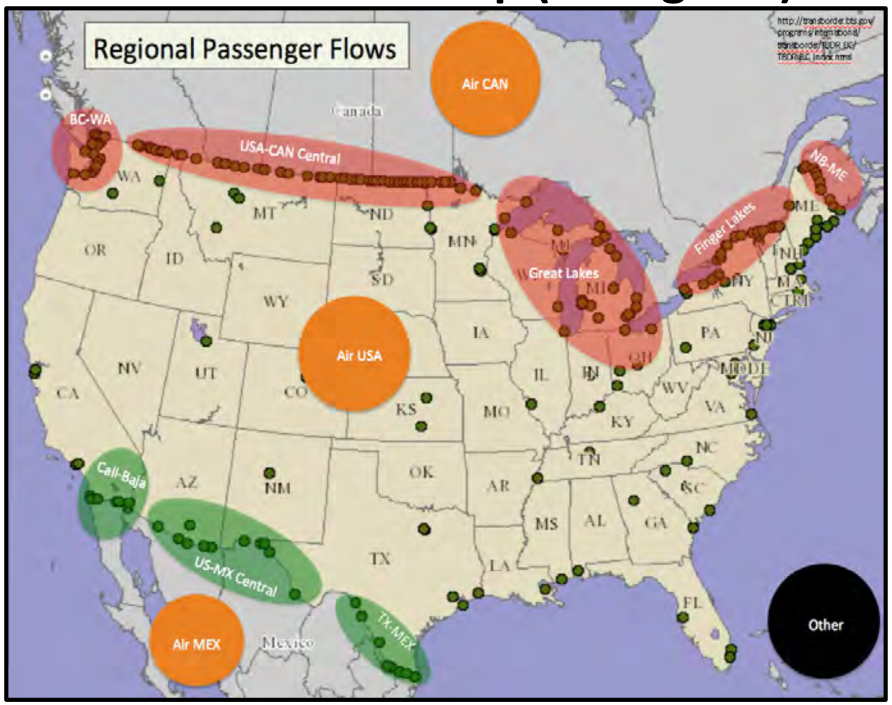
Range	
Lower Value	Upper Value
-0.30	0.36
-0.90	0.63
-0.30	0.64
0.30	1.13
-0.40	-0.27
-0.50	0.53

Note: Values range from -2 (strong negative growth) to +2 (strong positive growth)

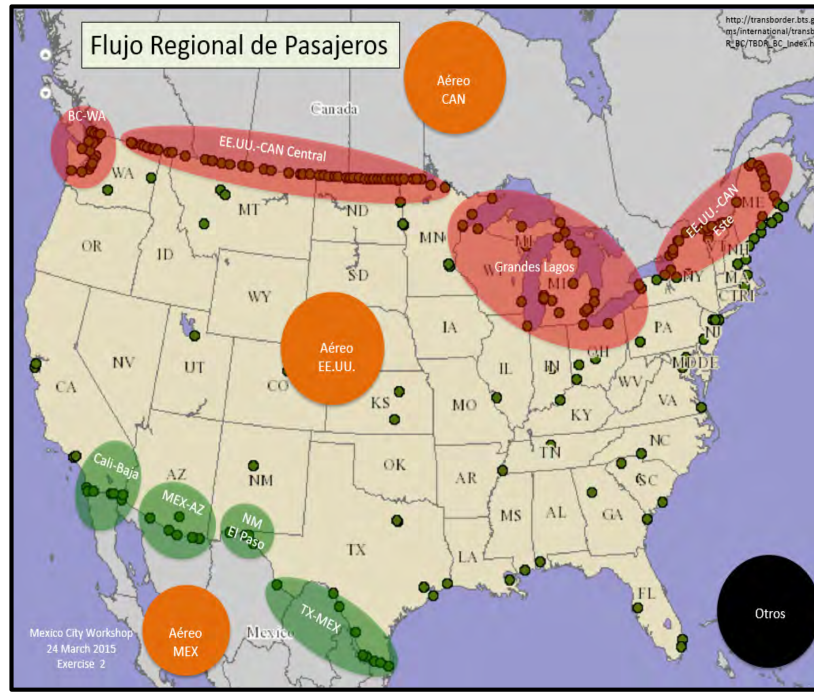
Future Regional Flows

Exercise 2: Passenger Flow by Region

Ottawa Workshop (12 regions)



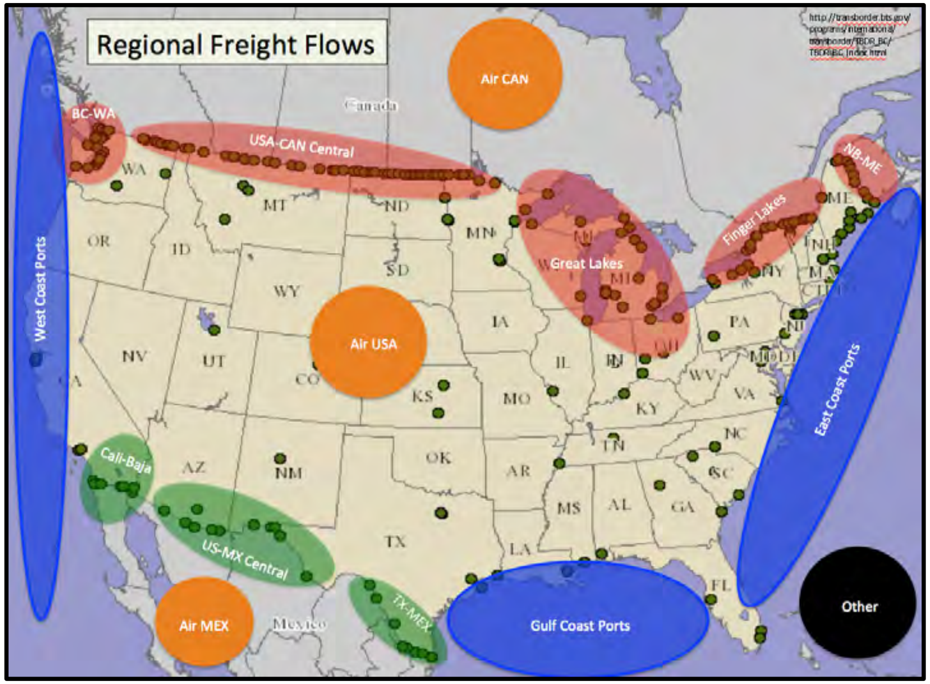
Mexico City Workshop (12 regions)



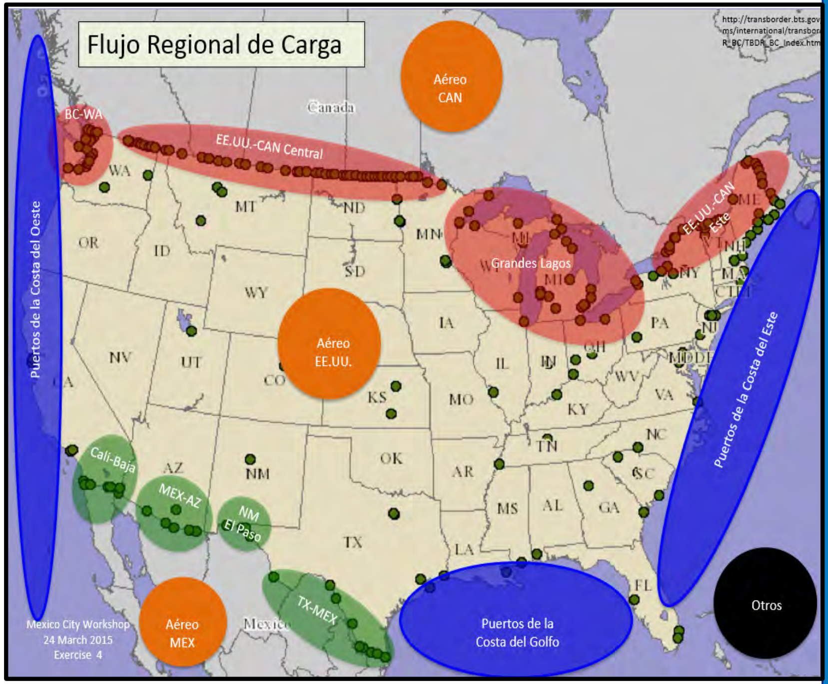
Future Regional Flows

Exercise 4: Freight Flow by Region

Ottawa Workshop (15 regions)



Mexico City Workshop (15 regions)



Naftástique!

Exercises 2 & 4: Passenger Flow by Region/Freight Flow by Region

Passenger Flow

Region	Ottawa Workshop		Mexico City Workshop	
	Points	%	Points	%
BC-WA	10	8%	1	0%
USA-CAN Central	5	4%	20	10%
Great Lakes	19	**16%**	9	4%
USA-CAN East*	9	8%	9	4%
Cali-Baja	13	11%	23	11%
USA-MEX Central**	6	5%	21	10%
TX-MX	16	13%	42	**21%**
Air CAN	8	7%	7	3%
Air USA	13	11%	25	12%
Air MEX	13	11%	25	12%
Other	0	0%	1	0%
Total =	**112**	**93%**	**183**	**90%**

Freight Flow

Region	Ottawa Workshop		Mexico City Workshop	
	Points	%	Points	%
BC-WA	18	12%	1	0%
USA-CAN Central	9	6%	10	4%
Great Lakes	27	**18%**	8	3%
USA-CAN East*	8	5%	7	3%
Cali-Baja	5	3%	26	10%
USA-MEX Central**	12	8%	27	11%
TX-MX	17	11%	57	**22%**
Air CAN	2	1%	6	2%
Air USA	8	5%	14	5%
Air MEX	3	2%	15	6%
East Coast	9	6%	8	3%
Gulf Coast	14	9%	27	11%
West Coast	0	0%	12	5%
Other	0	0%	0	0%
Total =	**132**	**88%**	**218**	**85%**

* The USA-CAN East Region comprises the Finger Lakes Region and the NB-ME Region

** The USA-MEX Central Region comprises the MEX-AZ Region and the NM-El Paso Region

One World Order

Exercises 2 & 4: Passenger Flow by Region/Freight Flow by Region

Passenger Flow

Region	Ottawa Workshop		Mexico City Workshop	
	Points	%	Points	%
BC-WA	6	5%	1	1%
USA-CAN Central	4	3%	3	2%
Great Lakes	13	11%	2	1%
USA-CAN East*	7	6%	6	3%
Cali-Baja	15	**13%**	21	11%
USA-MEX Central**	11	9%	34	**18%**
TX-MX	16	**13%**	31	16%
Air CAN	2	2%	4	2%
Air USA	3	3%	16	8%
Air MEX	3	3%	15	8%
Other	2	2%	7	4%
Total =	**82**	**68%**	**140**	**73%**

Freight Flow

Region	Ottawa Workshop		Mexico City Workshop	
	Points	%	Points	%
BC-WA	13	9%	0	0%
USA-CAN Central	7	5%	11	5%
Great Lakes	18	**12%**	2	1%
USA-CAN East*	10	7%	3	1%
Cali-Baja	7	5%	14	6%
USA-MEX Central**	11	7%	13	5%
TX-MX	10	7%	45	**19%**
Air CAN	1	1%	2	1%
Air USA	2	1%	7	3%
Air MEX	2	1%	12	5%
East Coast	17	11%	19	8%
Gulf Coast	14	9%	16	7%
West Coast	18	**12%**	9	4%
Other	4	3%	3	1%
Total =	**134**	**89%**	**156**	**65%**

* The USA-CAN East Region comprises the Finger Lakes Region and the NB-ME Region

** The USA-MEX Central Region comprises the MEX-AZ Region and the NM-El Paso Region

Global Marketplace

Exercises 2 & 4: Passenger Flow by Region/Freight Flow by Region

Passenger Flow

Region	Ottawa Workshop		Mexico City Workshop	
	Points	%	Points	%
BC-WA	10	8%	7	4%
USA-CAN Central	3	3%	5	3%
Great Lakes	11	9%	5	3%
USA-CAN East*	2	2%	12	7%
Cali-Baja	13	11%	35	**19%**
USA-MEX Central**	7	6%	32	18%
TX-MX	15	13%	25	14%
Air CAN	9	8%	16	9%
Air USA	13	11%	17	9%
Air MEX	18	**15%**	23	13%
Other	11	9%	3	2%
Total =	**112**	**93%**	**180**	**100%**

Freight Flow

Region	Ottawa Workshop		Mexico City Workshop	
	Points	%	Points	%
BC-WA	9	6%	4	2%
USA-CAN Central	13	9%	7	3%
Great Lakes	13	9%	3	1%
USA-CAN East*	5	3%	4	2%
Cali-Baja	12	8%	19	8%
USA-MEX Central**	10	7%	32	14%
TX-MX	11	7%	34	**15%**
Air CAN	3	2%	10	4%
Air USA	7	5%	11	5%
Air MEX	6	4%	18	8%
East Coast	13	9%	17	8%
Gulf Coast	8	5%	14	6%
West Coast	17	**11%**	34	**15%**
Other	6	4%	7	3%
Total =	**133**	**89%**	**214**	**95%**

* The USA-CAN East Region comprises the Finger Lakes Region and the NB-ME Region
** The USA-MEX Central Region comprises the MEX-AZ Region and the NM-El Paso Region

Millions of Markets

Exercises 2 & 4: Passenger Flow by Region/Freight Flow by Region

Passenger Flows

Region	Ottawa Workshop		Mexico City Workshop	
	Points	%	Points	%
BC-WA	12	10%	1	1%
USA-CAN Central	2	2%	7	4%
Great Lakes	6	5%	9	5%
USA-CAN East*	6	5%	10	6%
Cali-Baja	1	1%	18	10%
USA-MEX Central**	0	0%	10	6%
TX-MX	0	0%	17	9%
Air CAN	23	19%	19	11%
Air USA	26	**22%**	27	15%
Air MEX	3	3%	34	**19%**
Other	0	0%	5	3%
Total =	**79**	**66%**	**157**	**87%**

Freight Flows

Region	Ottawa Workshop		Mexico City Workshop	
	Points	%	Points	%
BC-WA	9	6%	0	0%
USA-CAN Central	7	5%	3	1%
Great Lakes	6	4%	2	1%
USA-CAN East*	9	6%	8	4%
Cali-Baja	1	1%	7	3%
USA-MEX Central**	1	1%	16	7%
TX-MX	0	0%	19	8%
Air CAN	9	6%	14	6%
Air USA	9	6%	24	11%
Air MEX	3	2%	18	8%
East Coast	10	**7%**	26	**12%**
Gulf Coast	6	4%	18	8%
West Coast	9	6%	21	9%
Other	0	0%	5	2%
Total =	**79**	**53%**	**181**	**80%**

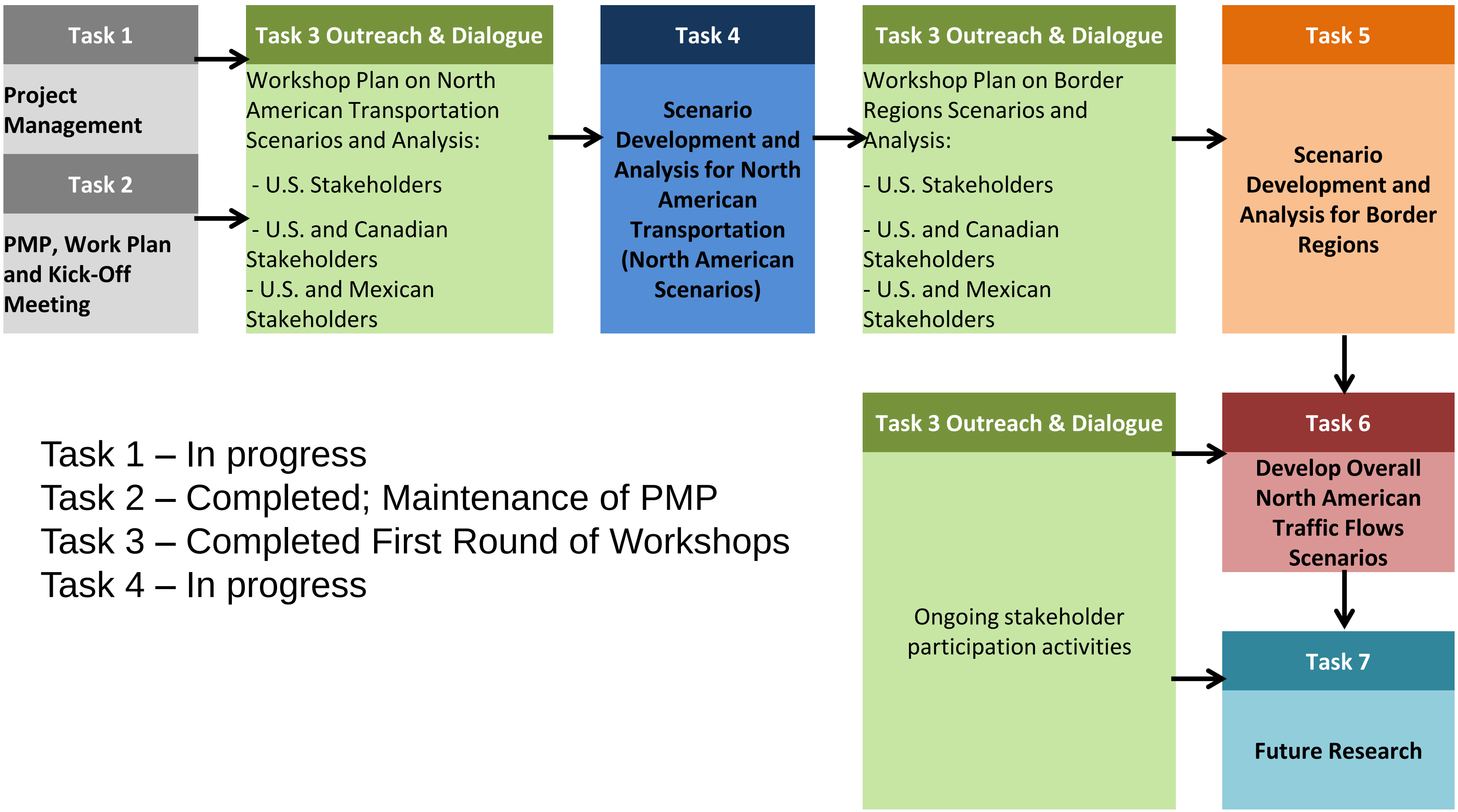
* The USA-CAN East Region comprises the Finger Lakes Region and the NB-ME Region

** The USA-MEX Central Region comprises the MEX-AZ Region and the NM-El Paso Region

Next Steps

- Complete the model framework (April-May 2015)
- Develop the **baseline forecast** with framework (passengers & freight) through 2045 (May-June 2015)
- Outreach to Border Regions in second series of workshops (Summer 2015)
- Develop the **scenario forecast** (passengers & freight) through 2045 for each of the four future scenarios (Late Summer-Fall 2015)
- Development of Report and Visualization System (Fall 2015)
- Final Report March 2016

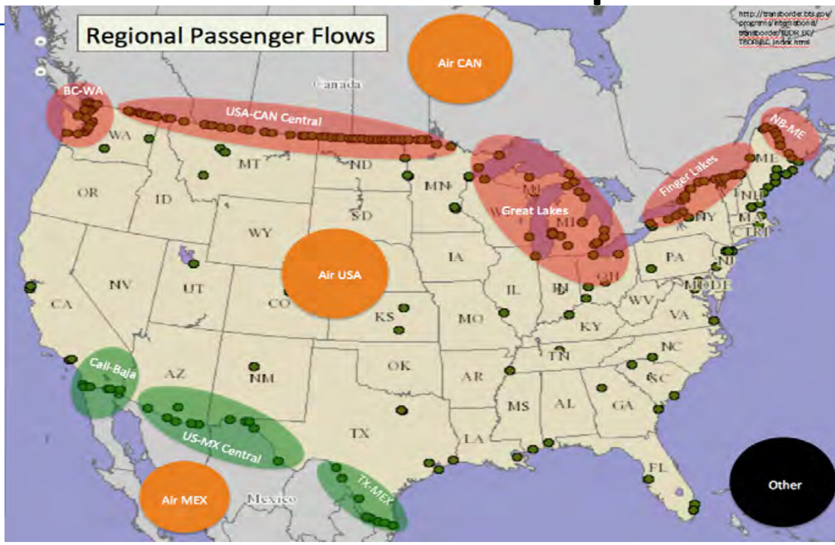
High-Level Overview of the Project Workflow

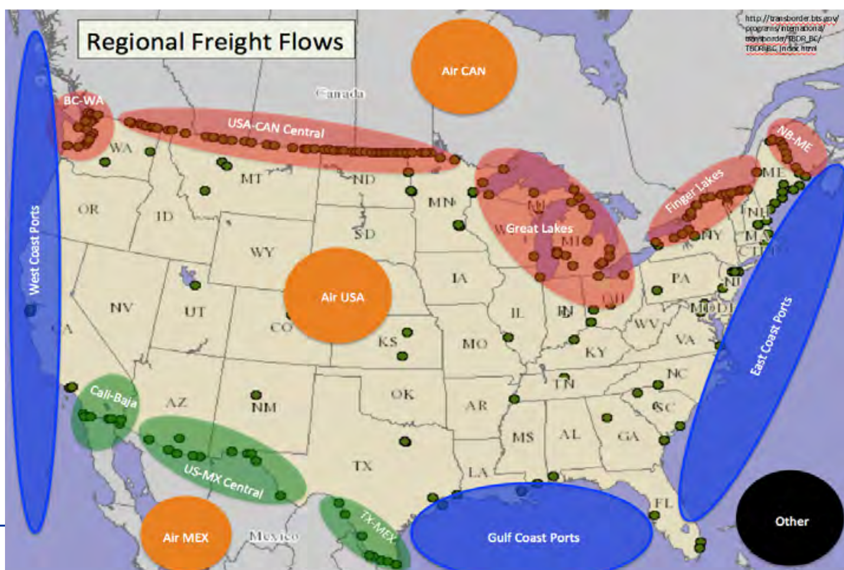


Task 1 – In progress
Task 2 – Completed; Maintenance of PMP
Task 3 – Completed First Round of Workshops
Task 4 – In progress

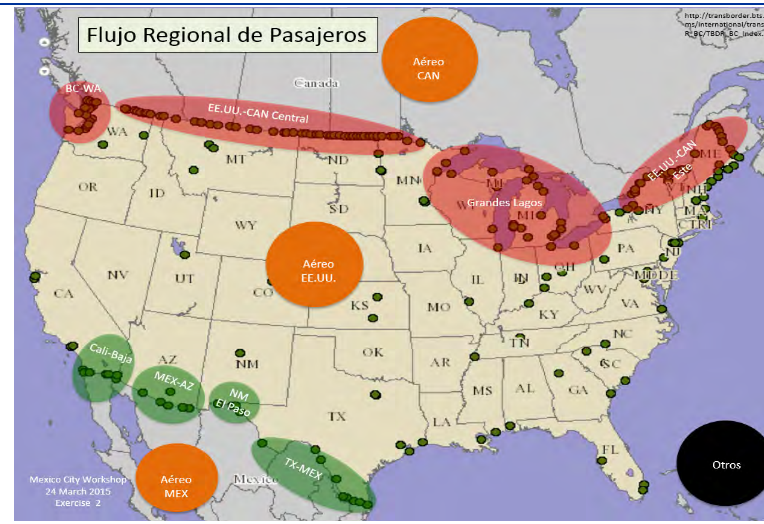
Investment Needs by Region

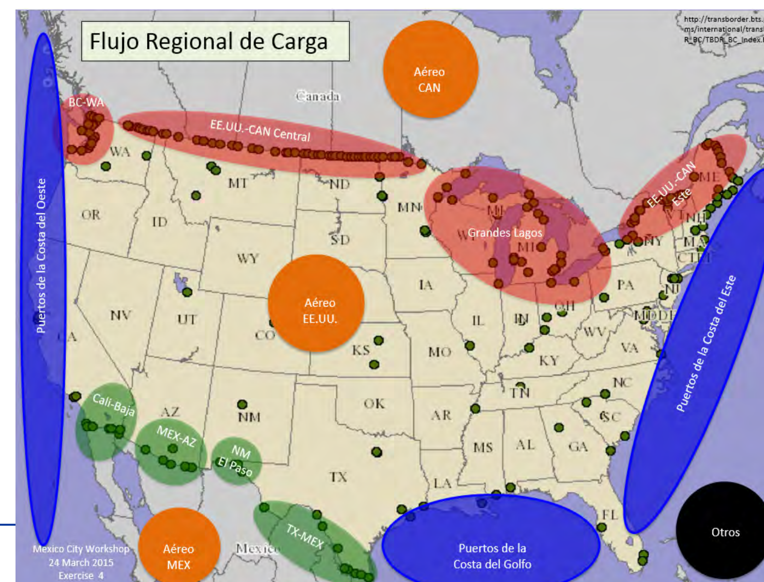
Ottawa Workshop





Mexico City Workshop





Investment needs by Region

Ottawa Workshop

Region	Passenger Flows		Freight Flows	
	Votes	%	Votes	%
BC-WA	1	2.5%	2	5.0%
USA-CAN Central	4	10.0%	3	7.5%
Great Lakes + Finger Lakes	18	45.0%	28	70.0%
NB-ME	0	0.0%	0	0.0%
Cali-Baja	0	0.0%	0	0.0%
USA-MEX Central**	5	12.5%	0	12.5%
TX-MX	1	2.5%	3	2.5%
Air CAN	2	5.0%	0	5.0%
Air USA	1	2.5%	0	2.5%
Air MEX	1	2.5%	0	2.5%
East Coast	N/A	N/A	0	N/A
Gulf Coast	N/A	N/A	0	N/A
West Coast	N/A	N/A	4	N/A
Other	0	0.0%	0	0.0%
Total =	**33**	**82.5%**	**40**	**100.0%**

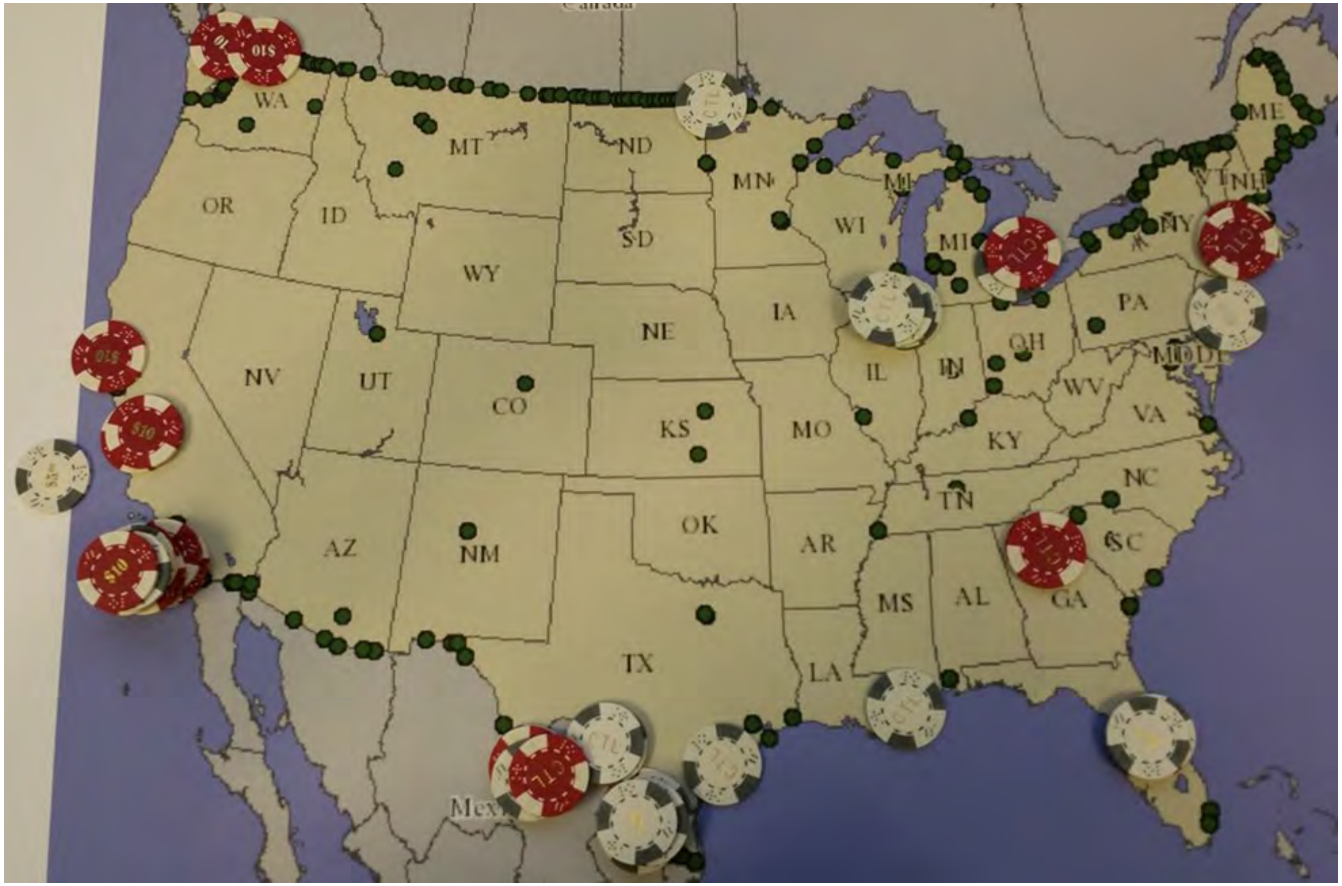
Mexico City Workshop

Region	Passenger Flows		Freight Flows	
	Votes	%	Votes	%
BC-WA	0	0.0%	0	0.0%
USA-CAN Central	0	0.0%	0	0.0%
Great Lakes	0	0.0%	0	0.0%
USA-CAN East*	0	0.0%	0	0.0%
Cali-Baja	11	17.5%	1	1.6%
USA-MEX Central**	1	1.6%	1	1.6%
TX-MX	9	14.3%	20	31.7%
Air CAN	0	0.0%	0	0.0%
Air USA	0	0.0%	0	0.0%
Air MEX	13	20.6%	0	0.0%
East Coast	N/A	N/A	0	0/0%
Gulf Coast	N/A	N/A	4	6%
West Coast	N/A	N/A	8	13%
Other	0	0.0%	0	0.0%
Total =	**34**	**54.0%**	**34**	**54.0%**

* The USA-CAN East Region comprises the Finger Lakes Region and the NB-ME Region
** The USA-MEX Central Region comprises the MEX-AZ Region and the NM-El Paso Region

Investment needs by Region

Washington DC Workshop



G. JUNE 2016 WORKSHOPS

Please see attached Power Point file

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US Department of Transportation
Federal Highway Administration

June 6-10, 2016

Stakeholders Meeting

Scenario Planning of Future Freight and Passenger Traffic Flows Across the U.S./Mexico and U.S./Canada Borders

Contract Number:
DTFH61-11-D-00017/5009

Any opinions, findings and conclusions or recommendations expressed in this presentation are those of the author(s) and do not necessarily reflect the views of the Federal Highway Administration.

Presentation Summary

1. Study Objectives
2. Overall Approach
3. Presentation of Analytical Results
4. Summary of Findings
5. Application & Implications
6. Next steps

Study Objectives

- Develop an analytical framework to represent border crossings for freight and passengers
- Use the analytical framework to forecast passenger and freight demand
- Apply “Scenario Planning” as a tool to identify hypothetical scenarios possibly affecting border crossings
- Quantify the impact of scenarios on passenger and freight border crossings through 2045

Scenario Planning

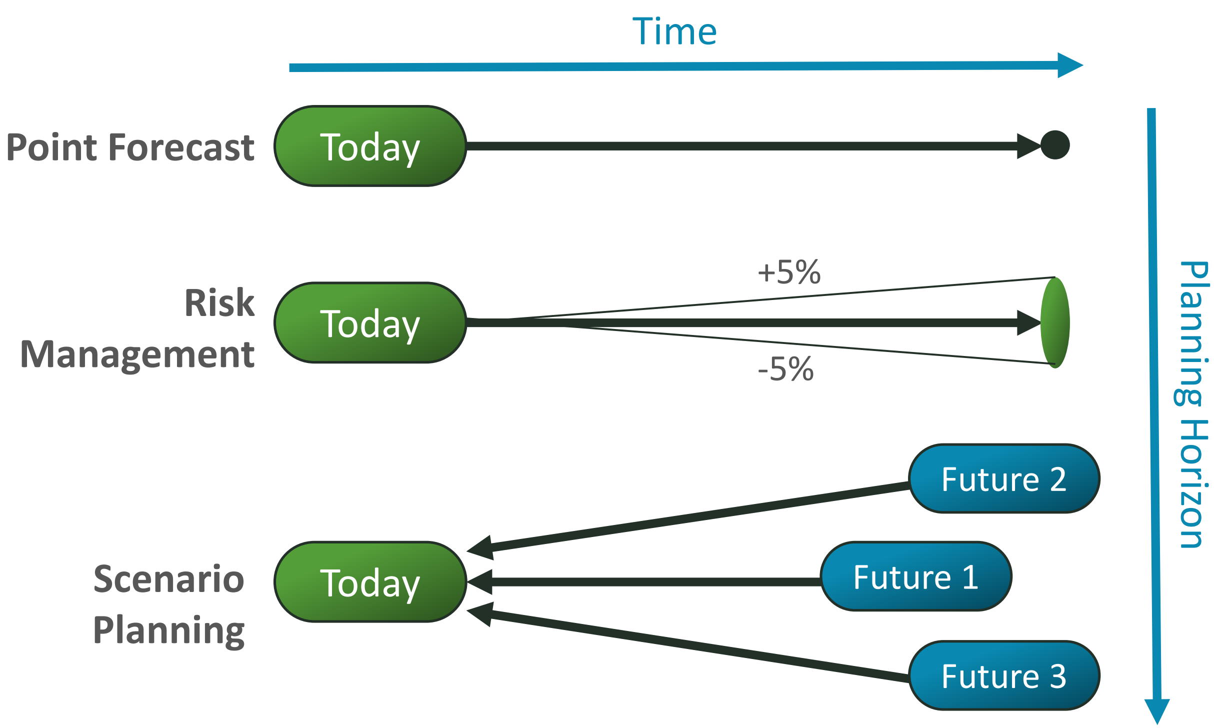
Planning Techniques

Traditional planning techniques generally focus on point forecasts

Risk Analysis generally looks at ranges of results

Scenario planning techniques shift from forecasting the future to preparing for potential depictions of future

Planning Methods



Multiple scenarios are developed and used as depictions of future

Scenarios Identified

- The following four scenarios were identified as a result of outreach and stakeholder dialogue in Summer 2015:
  - Naftástique
  - Global Marketplace
  - One World Order
  - Millions of Markets

Naftástique

World trade shifts away from a single global market as a small number of large regional trading blocs emerge. China, Europe, and South America form their own economic clusters. The United States joins with Mexico and Canada to make North America a self-sufficient economic community.

- US, Canada and Mexico form NAMEC (North American Economic Community).
- People and goods move freely between the United States, Canada, and Mexico.
- People live, work, and retire anywhere within bloc.
- NAMEC is energy independent
- Manufacturing has returned to NAMEC.
- Currency prices are stable within and across blocs.
- Energy prices are high but stable.
- Society and businesses are environmentally conscious
- Political regulations are strong. They have created blocs but seek to facilitate free flow within blocs.

Global Marketplace

This is a mercurial and hyper-competitive world. Trade takes place openly and vigorously among virtually all nations. Market-based approaches are used to face most contemporary challenges.

- Significant global trade that involves most countries — high level of collaboration across nations.
- Very high volatility in the supply of goods, currency values, and commodity prices.
- High level of virtual trade (intellectual property).
- Supply chains are very versatile yet reasonable in cost.
- Energy is cheap and available, yet the prices are highly volatile.
- Distributed global manufacturing footprint for most large companies.
- People prefer to live in large and dense cities — mega-cities are fast growing.
- Global companies achieve and leverage economies of scale.
- Governmental regulations exist mainly to support global trade.

One World Order

- Vital resources — energy, water, minerals, etc. — are scarce.
- Governments have created the World Sustainable Trade Organization (WSTO).
- Global trade has transformed to an ordered, less volatile and more predictable process.
- Although the invisible hand of the market still decides ‘what’ and ‘where’ to produce, it is the visible hand of regulation that dictates the ‘how’.
- Firms have adapted to a highly regulated environment.
- The objective of the WSTO regulations is to achieve a long-term global solution, not short- term firm profits.
- Cities grow bigger, yet the per-capita environmental impact decreases.
- Government discourages the home delivery of small/cheap packages through taxes and fees.
- Consolidation centers emerge in cities, to aggregate deliveries.
- Manufacturers have created large-scale production clusters and ultra-efficient supply chains.

Millions of Markets

Through advanced technological breakthroughs, the United States becomes highly self-reliant in terms of energy, agriculture, manufacturing, and other needs. There is increased migration towards smaller urban areas that are supported by nearby regional innovation hubs that can manufacture highly customized goods.

- The world has transformed into many self-sufficient clusters — countries and regions.
- Population is dispersed. The greatest population growth occurs in mid-sized cities.
- The U.S. is energy independent, mainly through natural gas and nuclear energy.
- Technology allows material to be maintained in the raw form until when needed for production
- Markets are mostly regional with demand being met by local supply
- Technological innovations have lowered economies of scale so that customized production in small batches is economically sound.
- Supply chains mostly carry undifferentiated/raw material for long distance and differentiated goods for short distance. (Undifferentiated material need not be cheap).
- People reuse & recycle — technology enables better recapture of the raw materials.
- Regional governments compete to make their region more attractive for businesses investment.

Framework Design Considerations

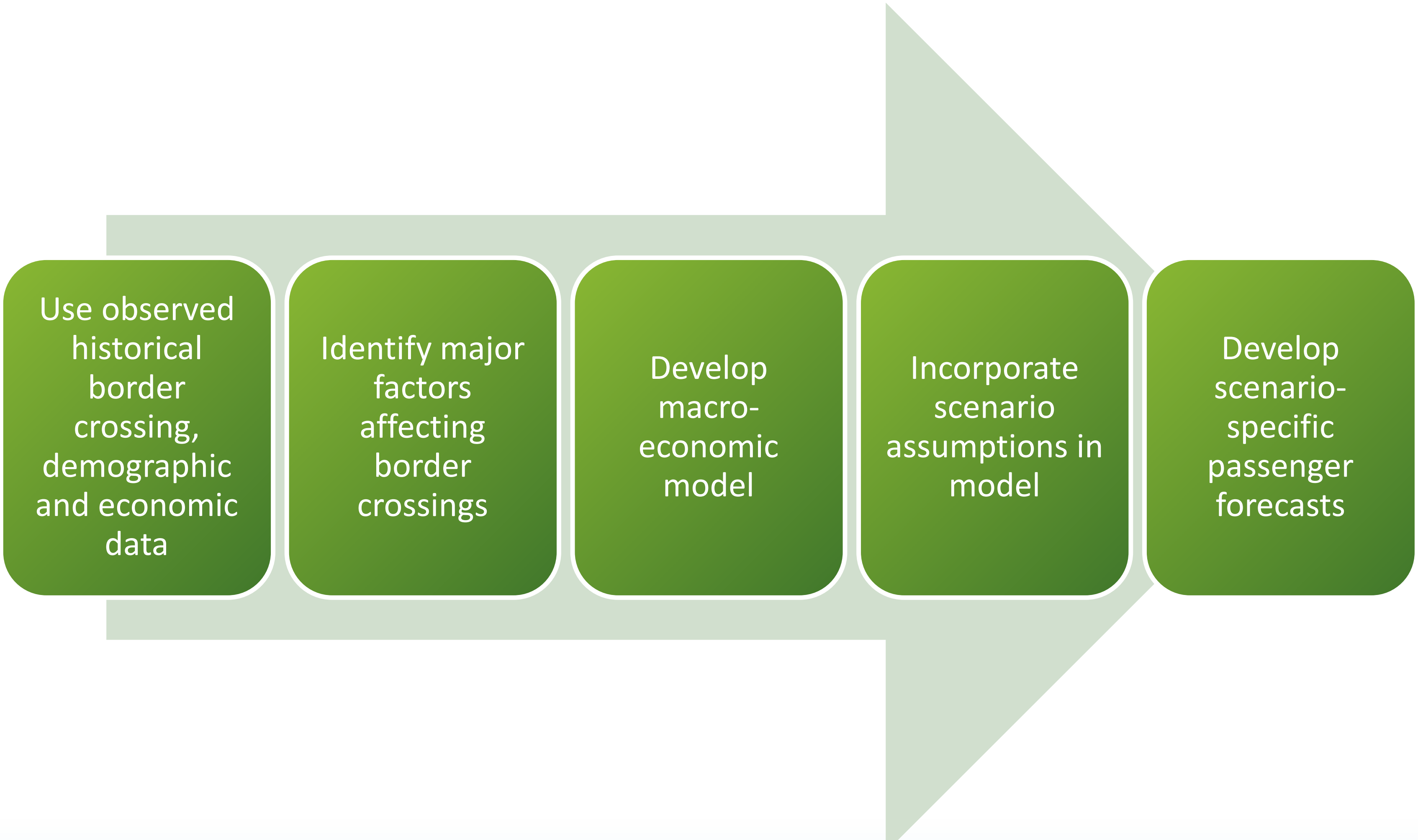
Analytical Framework

...Should be applicable to all border areas

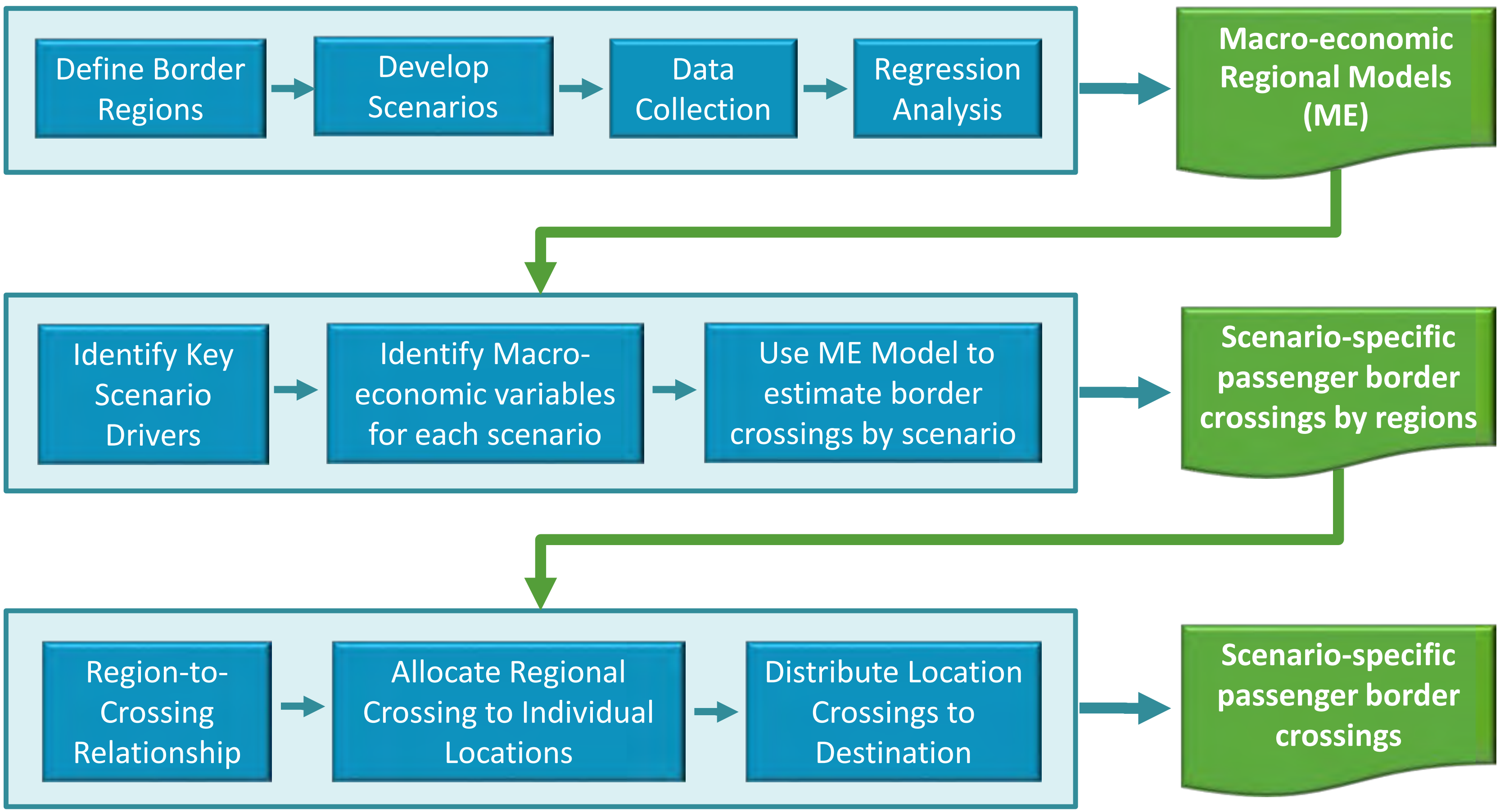
...Should be based on underlying drivers of border crossing for both passenger and freight

...Should be able to represent the above scenarios and allow additional "what-if" analysis

General Approach Passenger Analysis



Overall Analytical Approach (Passenger)



Border Regions Development Approach

Select US counties, Canada Census Divisions and Mexico Municipios

Group the above areas as per the general definition of border regions

Merge areas on either side of the border to define country-specific border regions

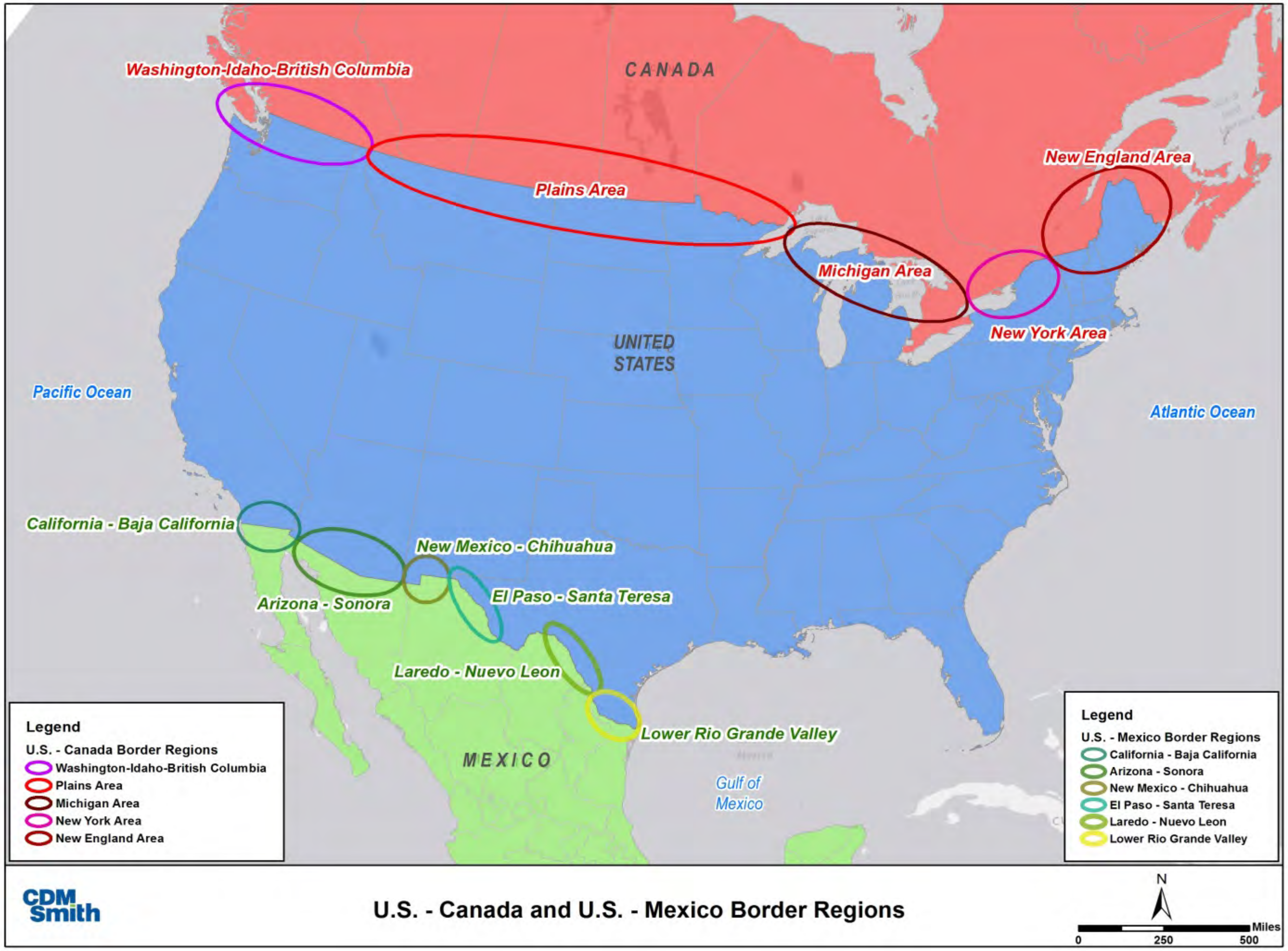
Merge corresponding regions on either side of border to define cross-border regions

Border Regions Development Considerations

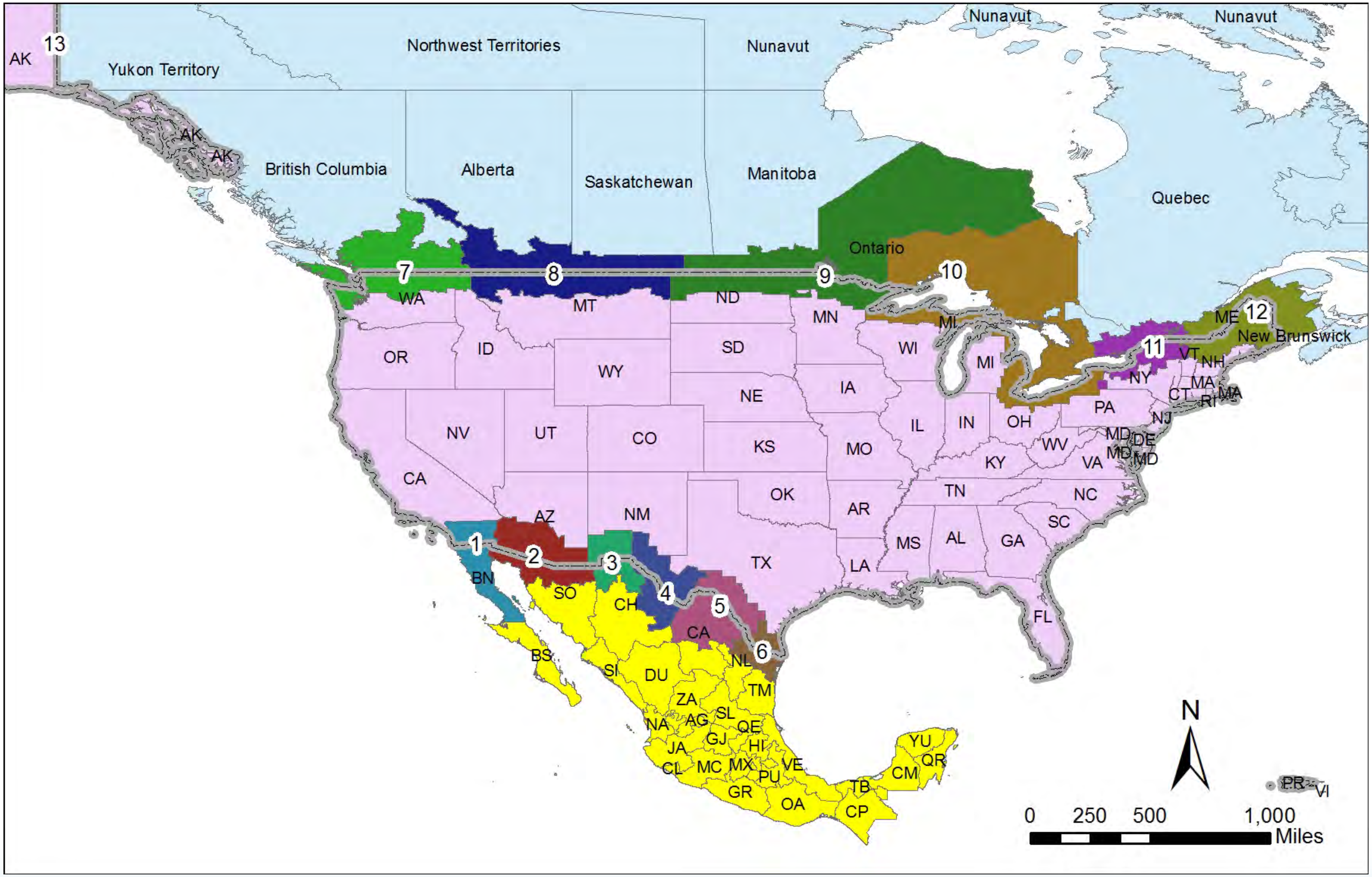
- Be based on a standard geography
- To have some level of consistency with US-Mexico JWC Border Area Masterplans

- Geographies Used:
  - US: Counties
  - Canada: Census Divisions
  - Mexico: Municipios
- Counties and Municipios 60 miles (100 km) on either side of border selected

Border Regions General Definition



Final Border Regions Definition



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Regression Analysis Summary

- A wide range of variables believed to potentially contribute to the number of border crossings were tested
- Separate variables were plugged into the regression equations and iteratively tested for significance
- Once a set of variables was discovered that seemed likely to yield a reasonable model, the model was fitted to the observed data
- The model that yielded the best fit in terms of R^2 was retained as the border crossing model for that region
- Not all variables were significant for all regions

Linear Regression Form: $Y = K + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_n X_n$

Where: Y is the dependent variable, X is a set of independent variables, β is a set of coefficients describing the impact of each X, and K is a constant

The dependent variable is the number of annual passenger border crossings

Independent variables are the various observed behaviors that influence the number of border crossings

Regression Analysis Summary Contd…

- Variables examined:
  - Population: Total and,
    - Ethnic groups,
    - Age cohorts,
    - Gender
  - Employment: Total and,
    - Agricultural,
    - Manufacturing,
    - Retail
  - Earnings
  - Income
  - Energy sources
  - Post 9-11 effects
  - Fuel Prices:
    - Crude Oil,
    - Gasoline
  - Enplanements
  - Average airfare
  - Unemployment rates
  - Average regional rainfall
  - Economic activity:
    - Gross Domestic Product,
    - Gross Regional Product
  - Currency exchange rates

Independent Variables US-Mexico

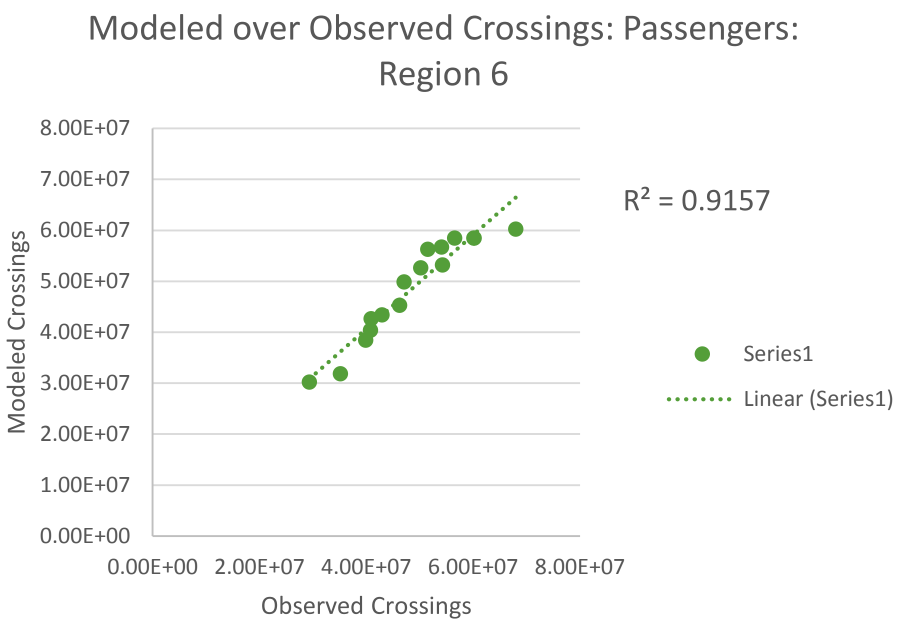
Variables	Region 1	Region 2	Region 3	Region 4	Region 5	Region 6
Gross Regional Product: US Border Region	+	+	+	+	+	+
Unemployment Rate: Mexico	-	-	-	-	-	-
Currency Exchange Rate: Mexico to US		+		+	+	+
Price of Crude Oil		-				
Price of Gasoline, California	-					
Price of Gasoline, Texas				-	-	-

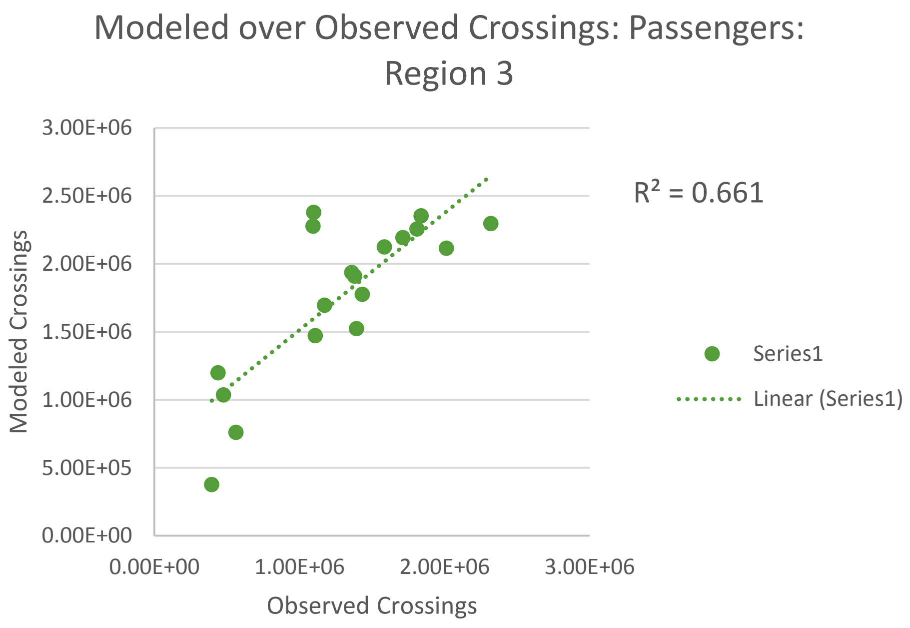
Independent Variables US-Canada

Variables	Region 7	Region 8	Region 9	Region 10	Region 11	Region 12	Region 13
Border Region Population: International		+				+	+
Border Region Population: Canada	+		+		+		
Ratio of Canadian Unemployment to US Unemployment		+	+				+
Border Region Employment: Canada, All	-				-	-	
Border Region Employment: US, All					+	+	
Border Region Employment: US, Manufacturing				+			
Currency Exchange Rate: Canada to US	+			+		+	
Price of Crude Oil			-				-
Price of Gasoline, MT		-					

Summary of Regression Analysis Output

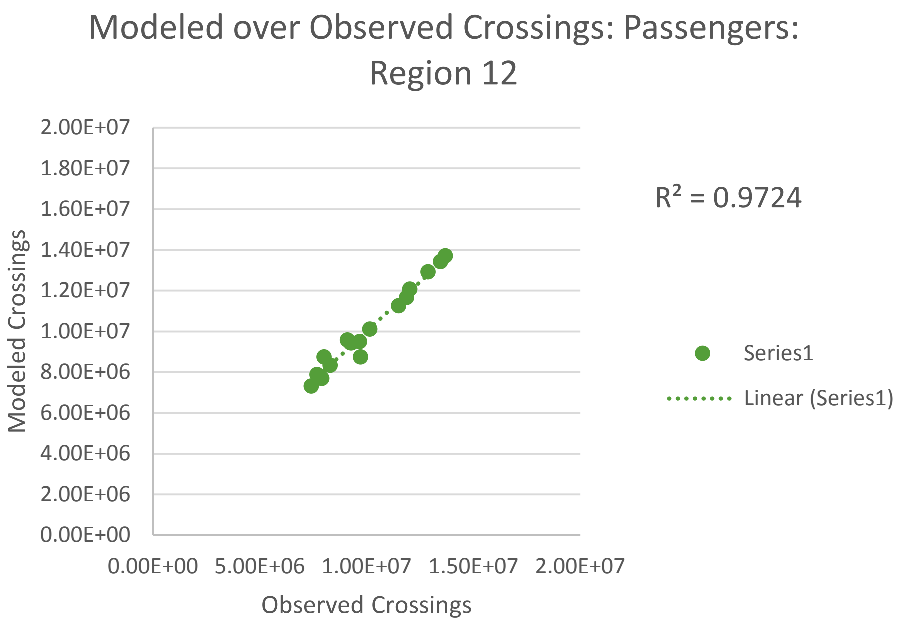
- US – Mexico Border: Best and Worst

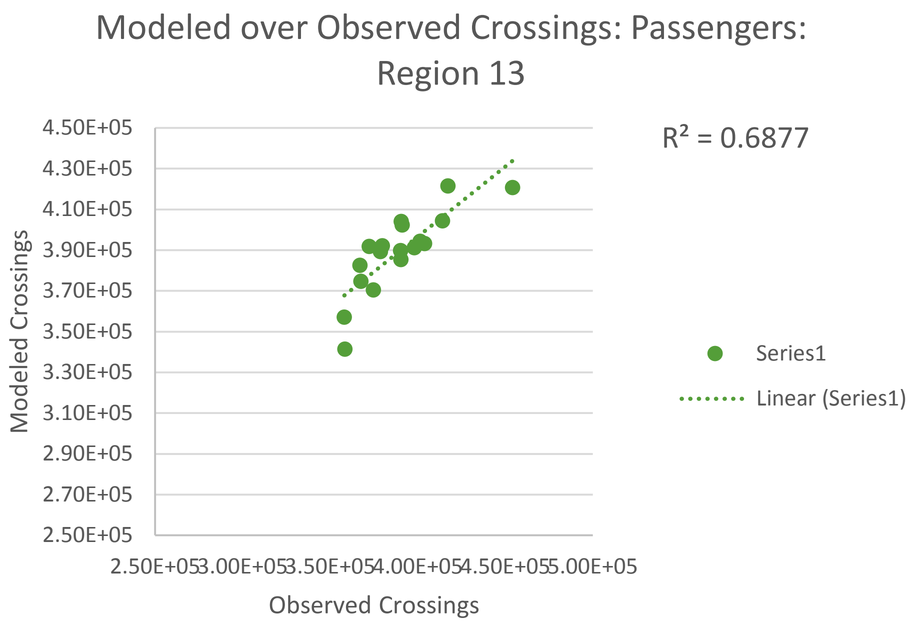




Summary of Regression Analysis Output

- US – Canada Border: Best and Worst





Summary of Regression Analysis Output

US – Mexico Border	Region 1	Region 2	Region 3	Region 4	Region 5	Region 6
R^2	0.86	0.81	0.66	0.73	0.71	0.92

US – Canada Border	Region 7	Region 8	Region 9	Region 10	Region 11	Region 12	Region 13
R^2	0.94	0.72	0.72	0.93	0.91	0.97	0.69

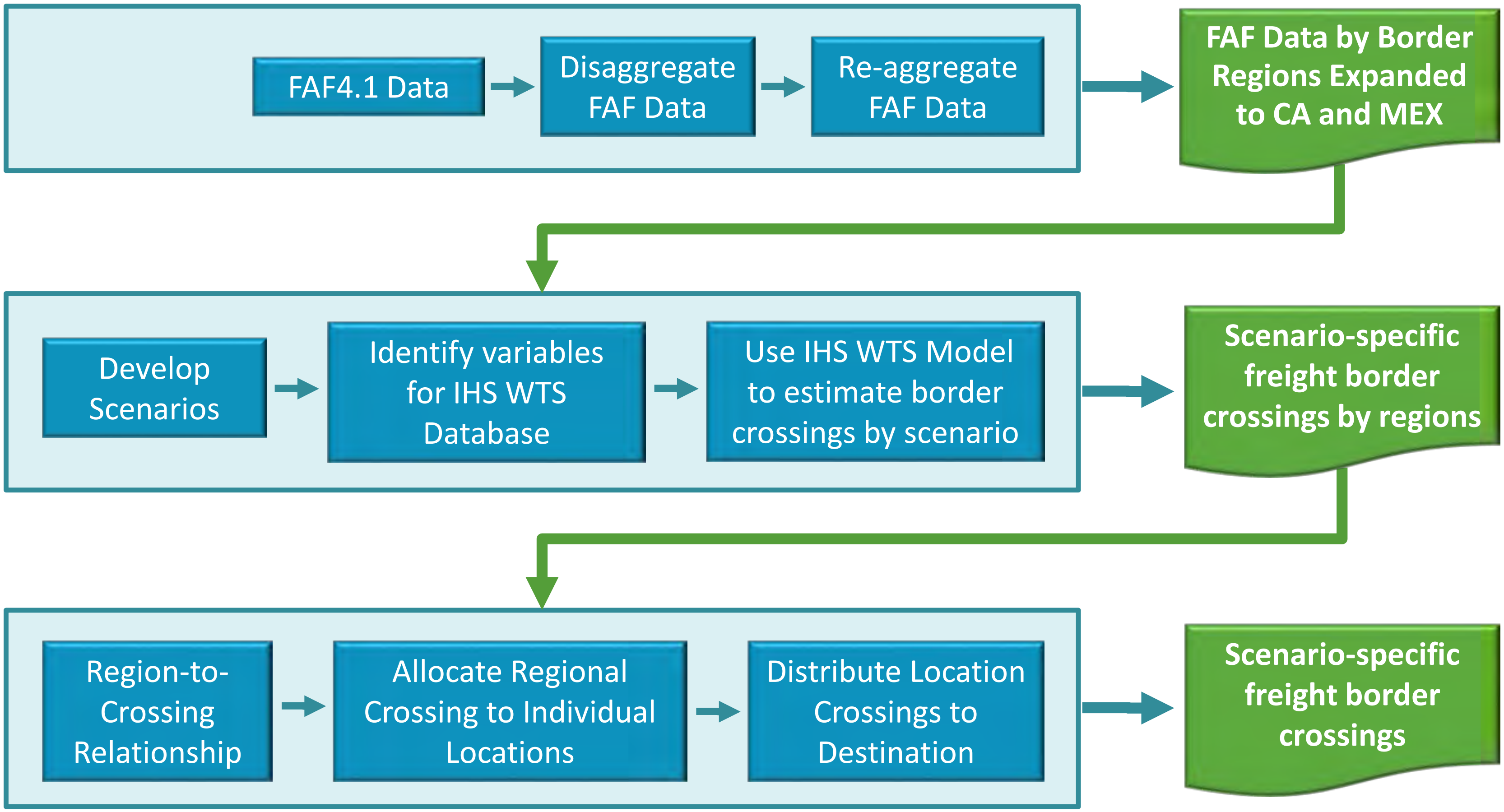
Scenario Assumptions Passengers

	Prevailing Trends	Naftastique	One World Order	Global Marketplace	Millions of Markets
Population	Significant and steady population growth along Canada's southern border as well as on both sides of the US - Mexico border. Population in the upper Midwestern and Northeastern US shows fairly low growth.	Steady population growth consistent with prevailing trends	Population growth significantly slows down in the border regions	Steady population growth consistent with prevailing trends	Steady population growth consistent with prevailing trends, except in British Columbia where population growth is slightly lower then the prevailing trend
Employment	Steady employment increases in most sectors of the economy in all countries except for manufacturing in the northern US, unemployment decreases a few tenths of a percent in the coming decades, but remains fairly stable at current levels	Overall increase in jobs in the US relative to prevailing trends including a return of manufacturing to northern states, sharp decline in unemployment in all three countries	Employment growth significantly slows down while unemployment increases.	Steady increase to employment consistent with prevailing trends plus a return of manufacturing to Northern states that begins to exceed historic growth rates, unemployment rates are consistent with prevailing trends	Steady increase to employment consistent with prevailing trends for most regions plus a slight return of manufacturing to northern states, Canadian employment growth in Ontario and Quebec exceed prevailing trends, unemployment rates are consistent with prevailing trends

Scenario Assumptions Passengers (cont.)

	Prevailing Trends	Naftastique	One World Order	Global Marketplace	Millions of Markets
Economic Activity	Steady positive economic growth in all three countries with especially strong economic growth in the Southern and Southwestern US	Significant increases to Gross Regional Product along the US-Mexico border relative to prevailing current trends	Economic growth along the US-Mexico border slows down considerably. Fuel prices increase faster than historic trends.	Continued growth in economic activity consistent with prevailing trends except in Regions 1, 4, and 10 where growth exceeds expected trends	Growth in economic activity along the US-Mexico Border slows down significantly with growth below the prevailing trends but still in the positive direction
Exchange Rates	Continued strengthening of the Canadian dollar against the US dollar until achieving near parity in the later years of the analysis. The Mexican peso strengthens against the US dollar in the short term before weakening slightly and stabilizing at slightly above current rates until weakening again to reach current rates in the latest years.	Continued strengthening of the Canadian dollar and Mexican peso consistent with prevailing trends	Continued strengthening of the Canadian dollar and Mexican peso consistent with prevailing trends	Continued strengthening of the Canadian dollar and Mexican peso consistent with prevailing trends	Canadian dollar strengthens against the US dollar but never quite achieves parity, the Mexican peso is consistent with the prevailing trends

Overall Analytical Approach (Freight)



General Scenario Assumptions Freight

- The latest FAF freight forecast used as the starting point
- For the purposes of scenario analysis, additional economic variables that form the basis of the FAF forecast were considered
- The baseline forecast of US GDP used to drive the long-term FAF forecast
- Additionally, the scenario analysis required a forecast of the US current account balance. The baseline balance of trade forecast used to calibrate the forecast scenarios

Freight Scenario Assumptions: Naftastique

- Overall trade between Canada, Mexico & United States described in scenario
- US population has moved towards the Southwest
- Growth of baseline trade adjusted to match scenario starting in 2015.
- Demand for goods & employment increased over baseline in SW states, decreased in Northeast.
- Naftastique scenario model is unique due to availability of NAFTA specific trade data!

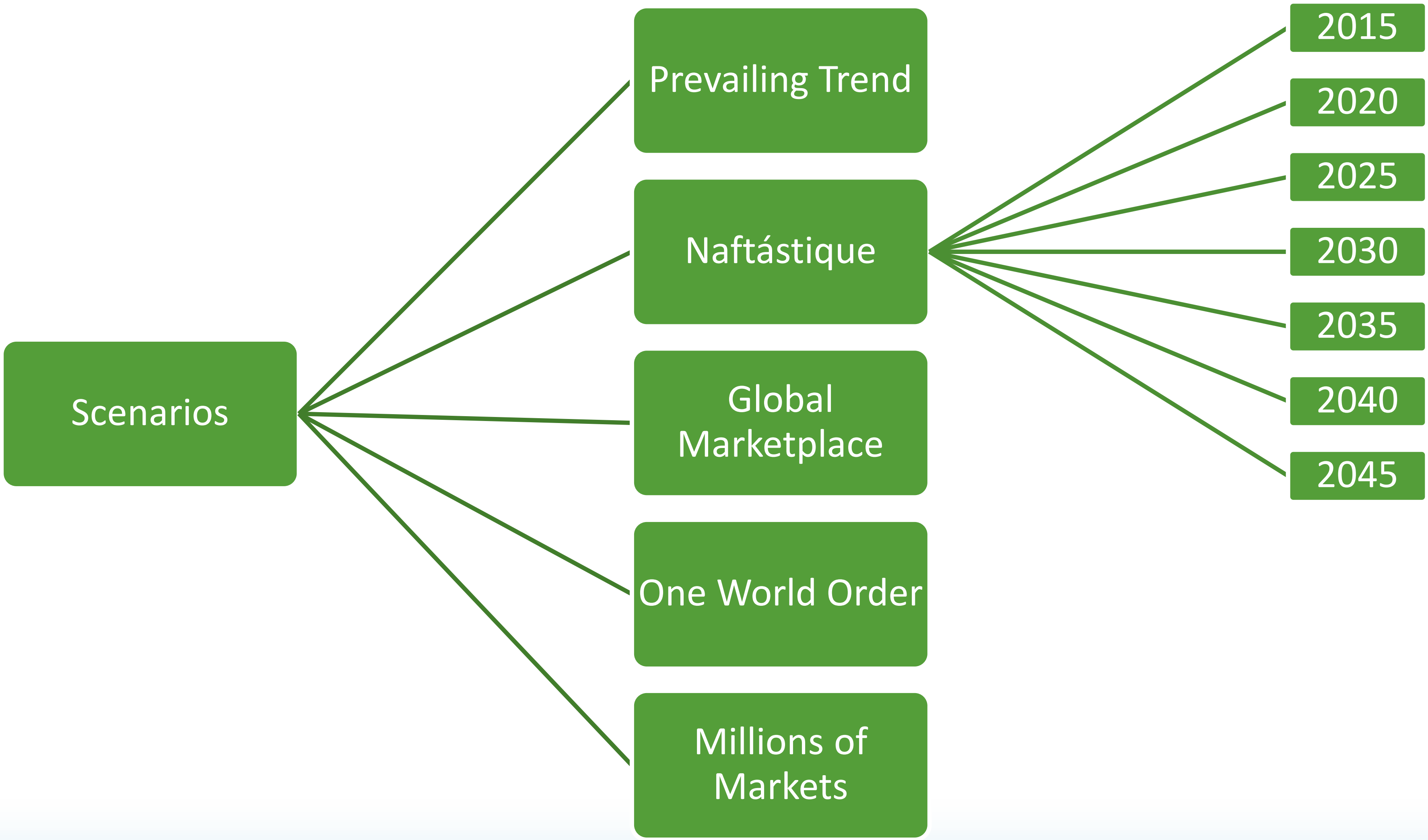
Freight Scenario Assumptions: Others

- GDP assumptions and current account balance available for all other scenarios
- These are used as inputs to the forecast model, adjusting the baseline data to produce new forecasts.

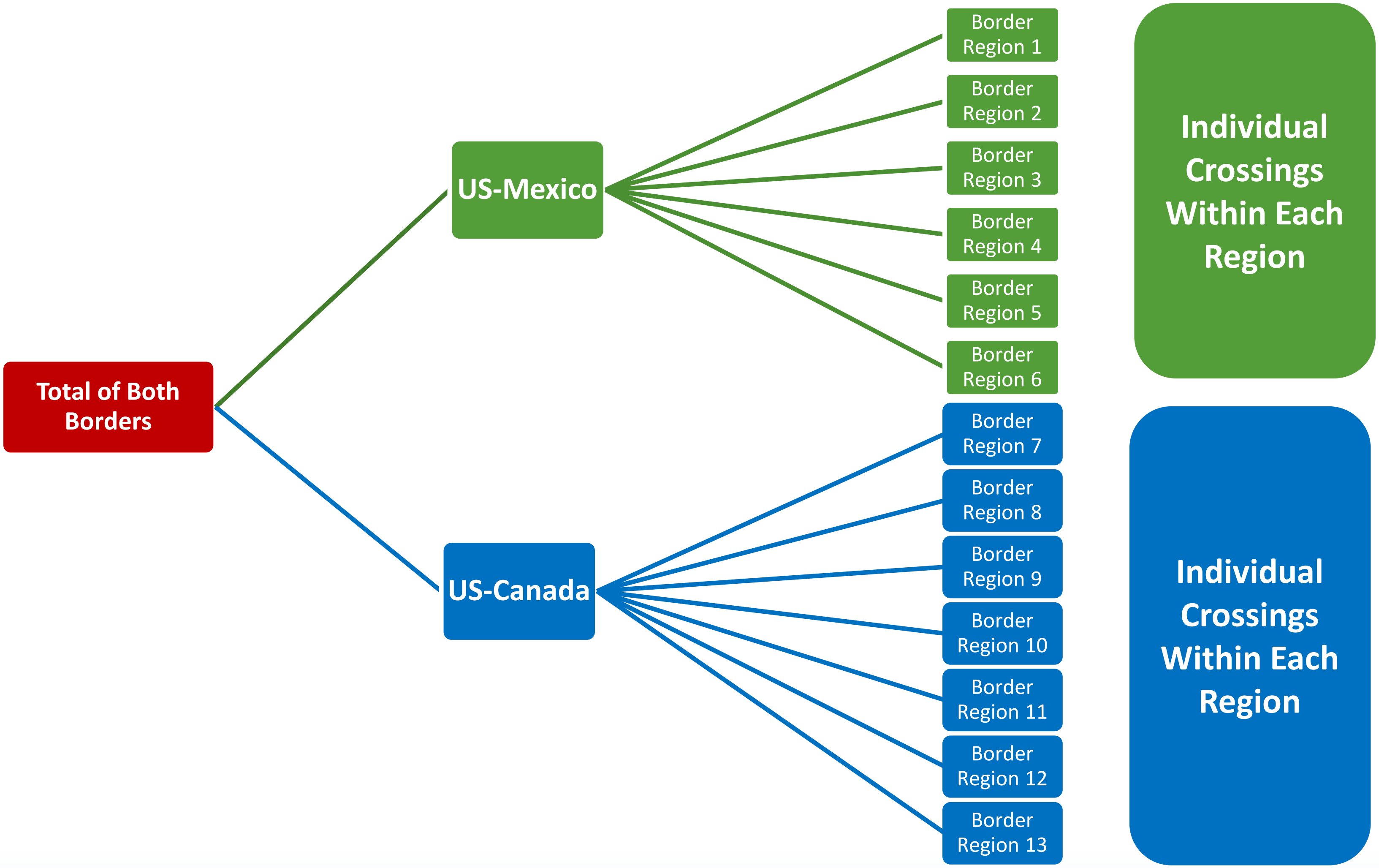
GDP in Trillions of USD by Scenario

Scenario	2015	2016	2020	2025	2030	2035	2040	2045	CAGR
FAF4	16.3	16.6	17.4	18.7	20.4	22.1	23.7	25.2	1.5%
One World Order	13.6	13.7	14.0	14.5	15.0	15.9	16.7	17.6	0.9%
Global Marketplace	14.8	15.1	16.3	18.5	20.8	23.4	26.0	28.9	2.3%
Millions of Markets	16.0	16.3	17.4	18.8	20.5	21.8	23.0	24.3	1.4%

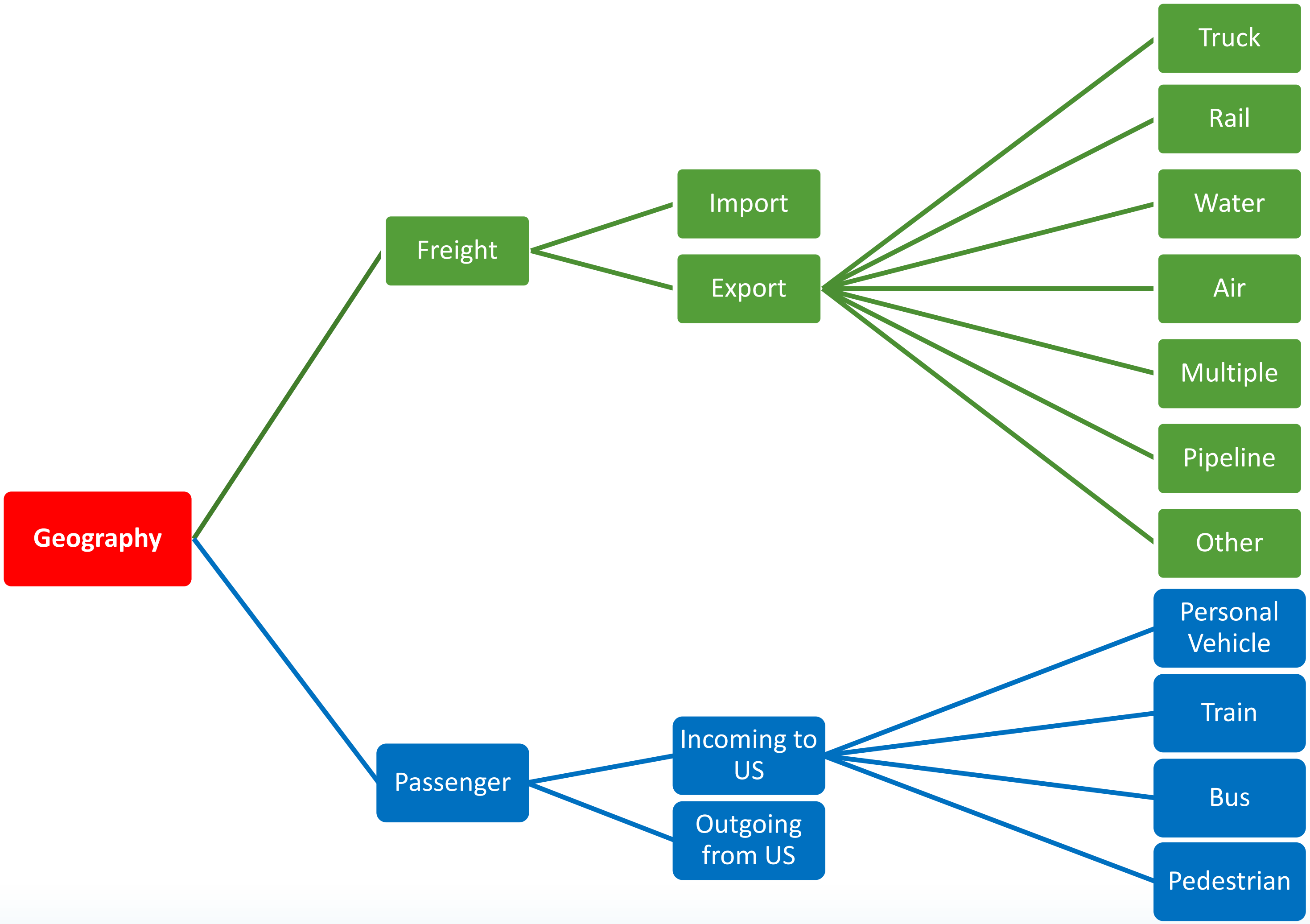
Results: Scenario/Temporal Hierarchy



Results: Geographical Hierarchy



Results: Modal Hierarchy



Approach to Results Review

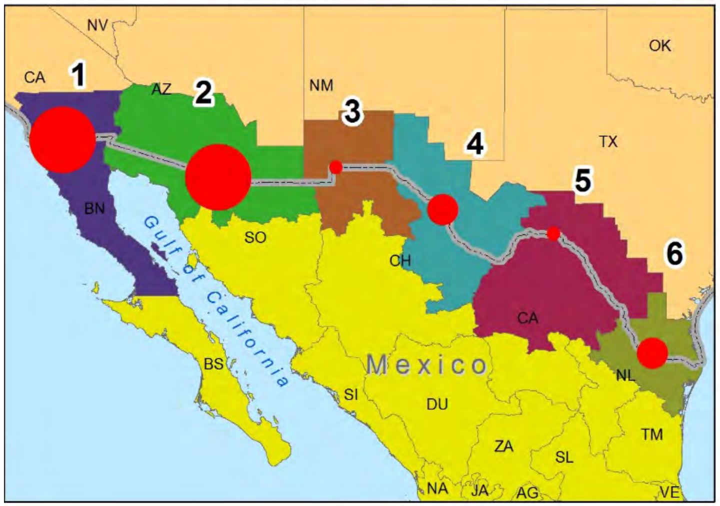
- Multi-dimensional data involved
- Too many combinations of information
- Results are simplified for presentation purposes
- Visualization tool being developed to facilitate analysis/viewing of results

Assumptions Related to Results

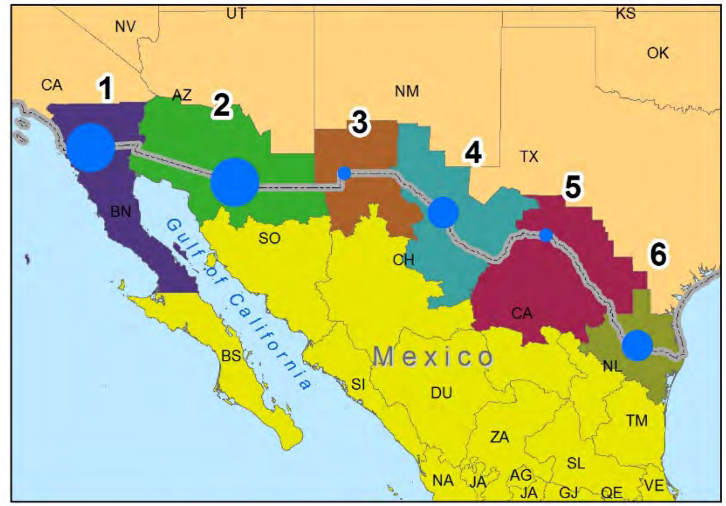
- Results assume that all scenarios have the same probability of occurrence
- Scenarios are assumed to be mutually exclusive events
- Freight data is generally expressed in terms of total annual tons crossing the border
- Passenger data is generally expressed in terms of total daily passengers crossing the border

Regional Attributes (US-Mexico)

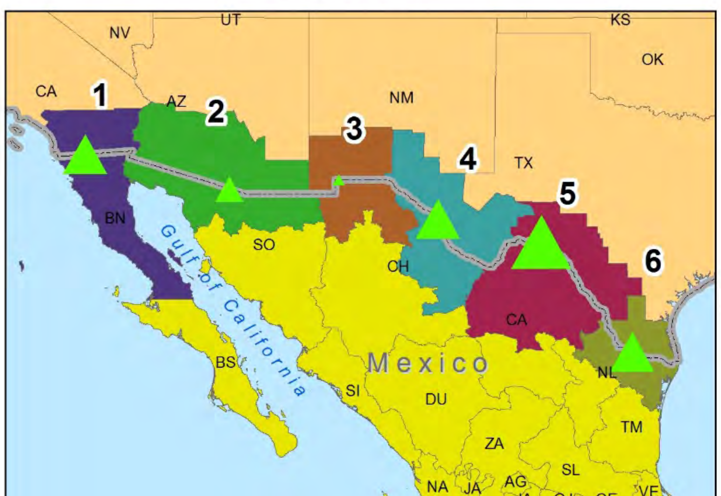
2015 Population



2015 Employment



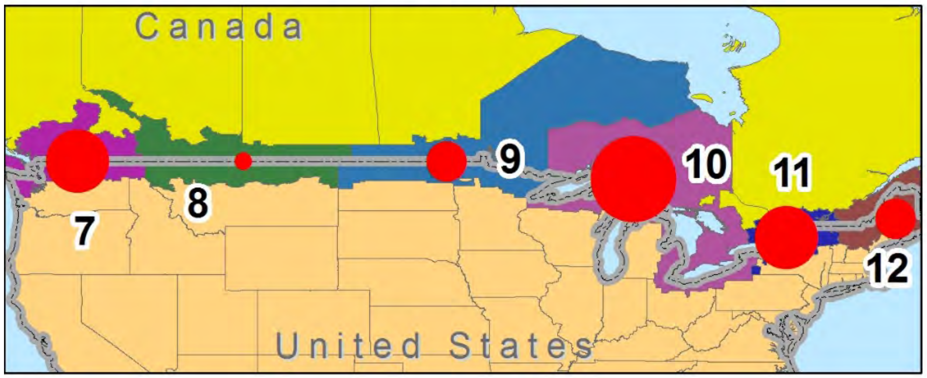
2014 Trucks



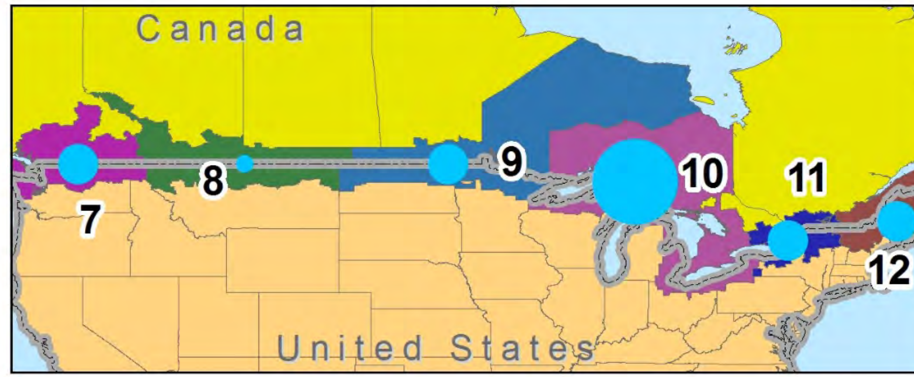
2014 Passenger Vehicles

Regional Attributes (US-Canada)

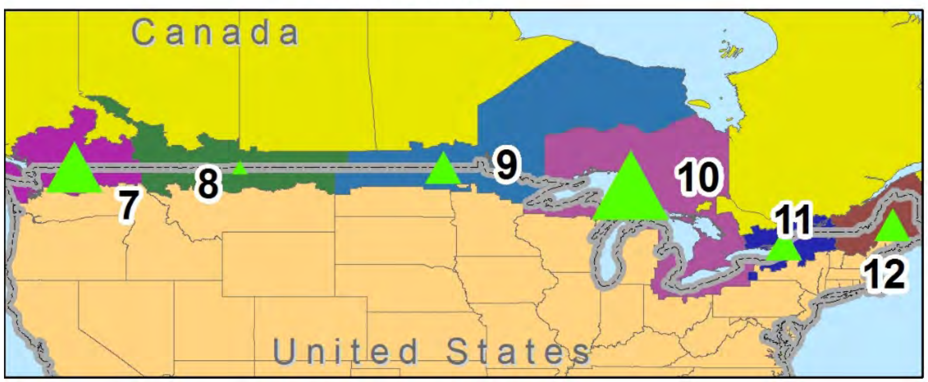
2015 Population



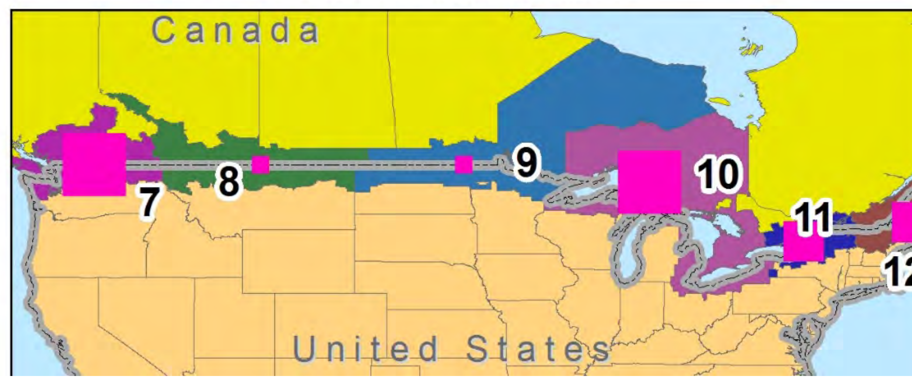
2015 Employment



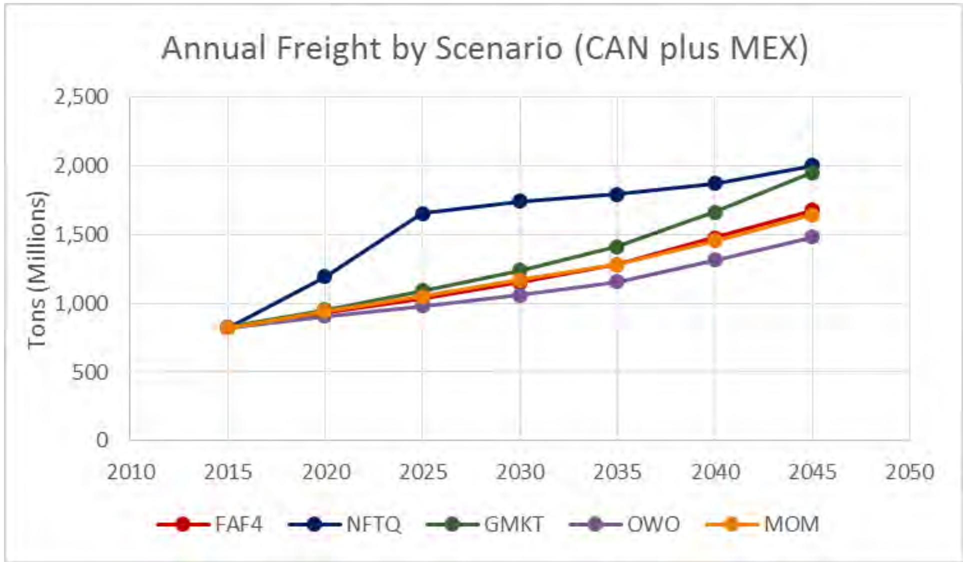
2014 Trucks

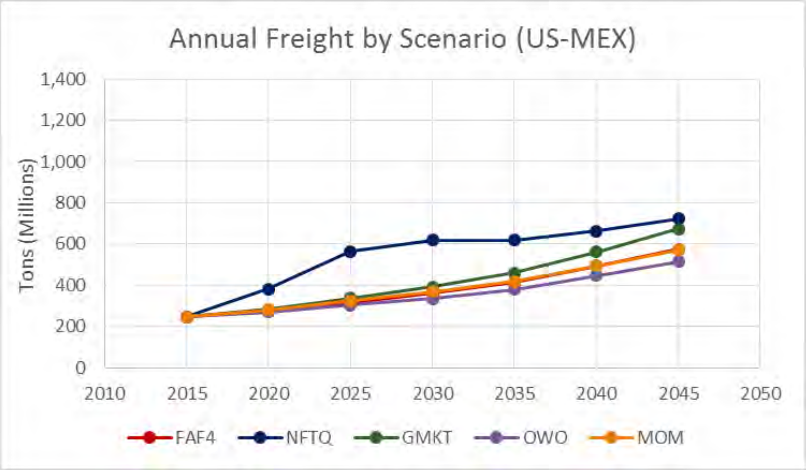


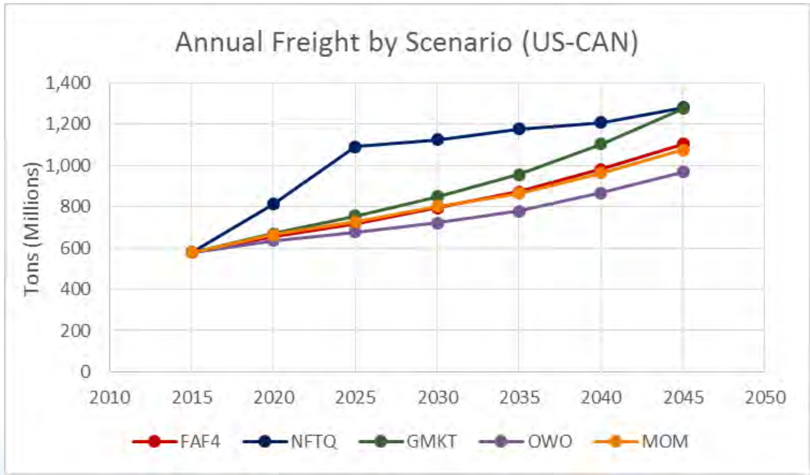
2014 Passenger Vehicles



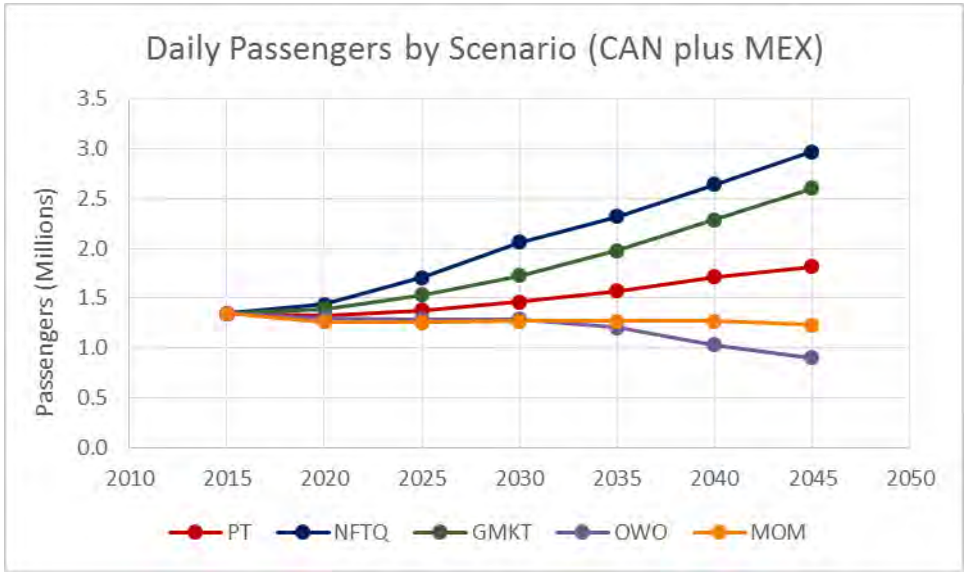
Total Freight by Scenarios

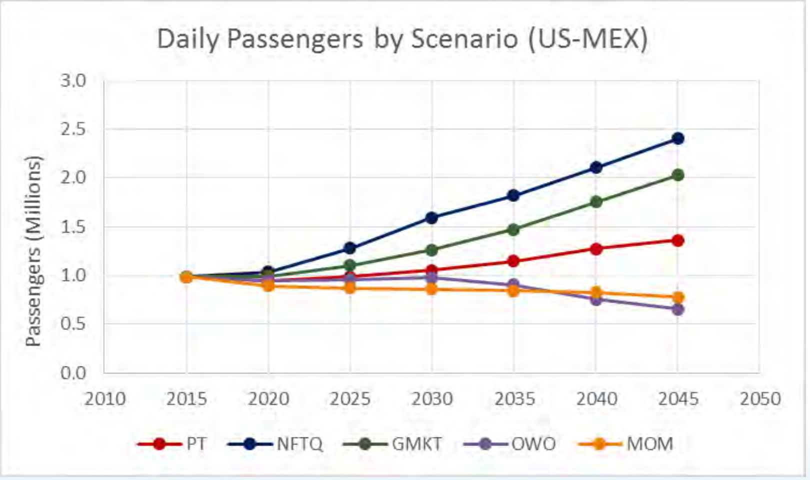


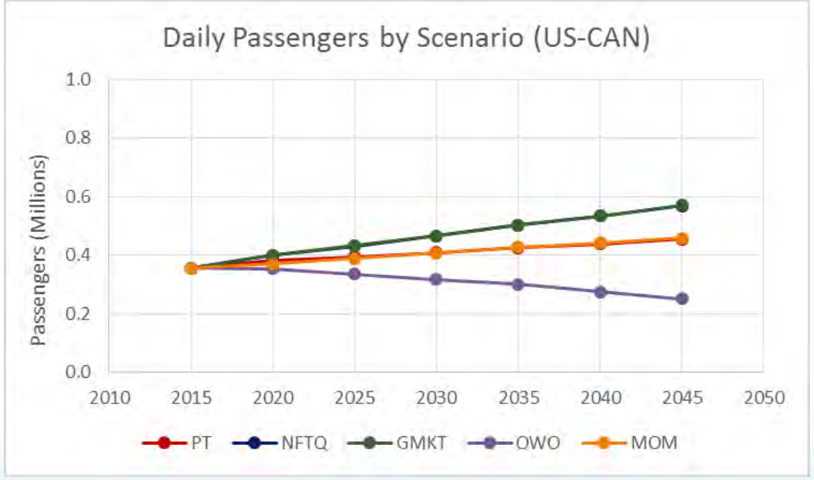




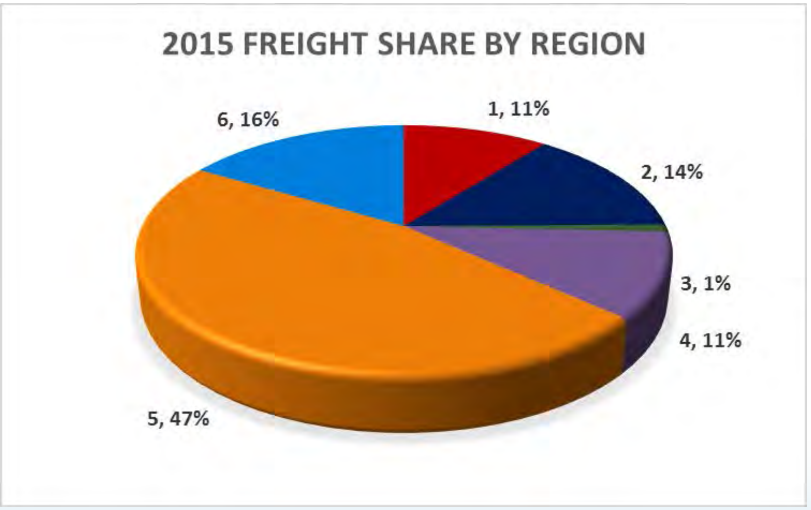
Total Passengers by Scenarios

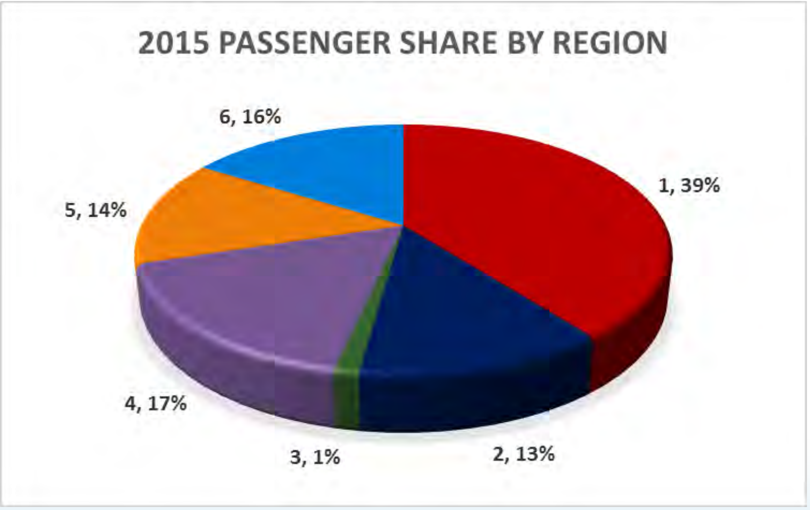




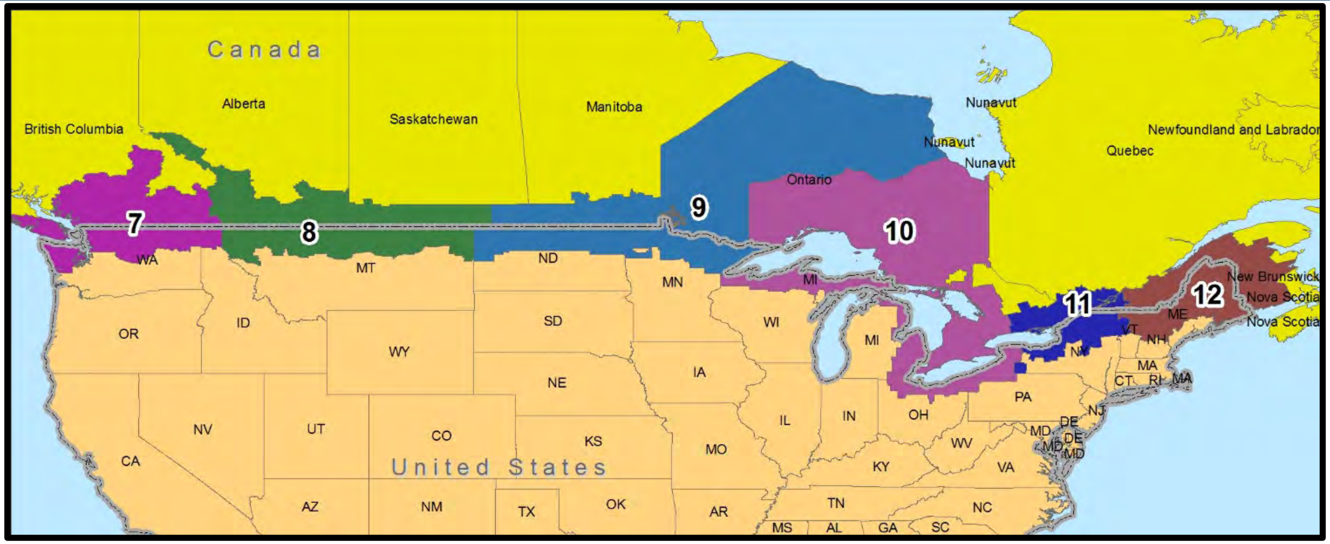


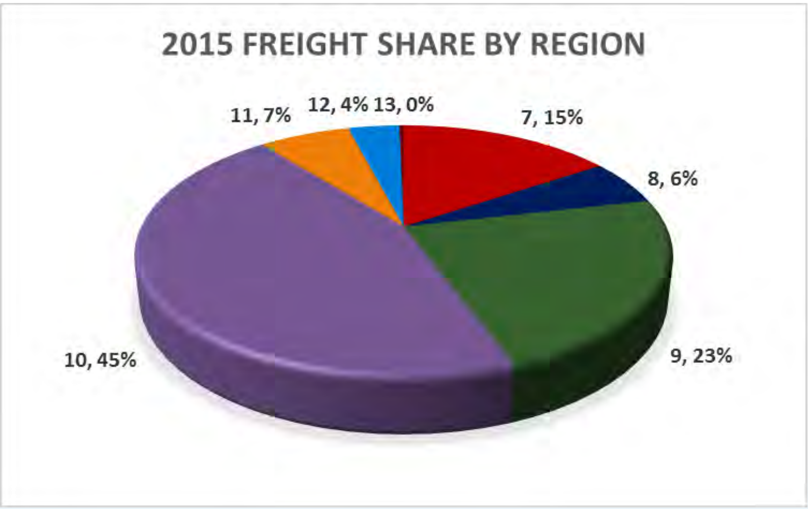
Freight & Passenger Share by Regions (US-Mexico)

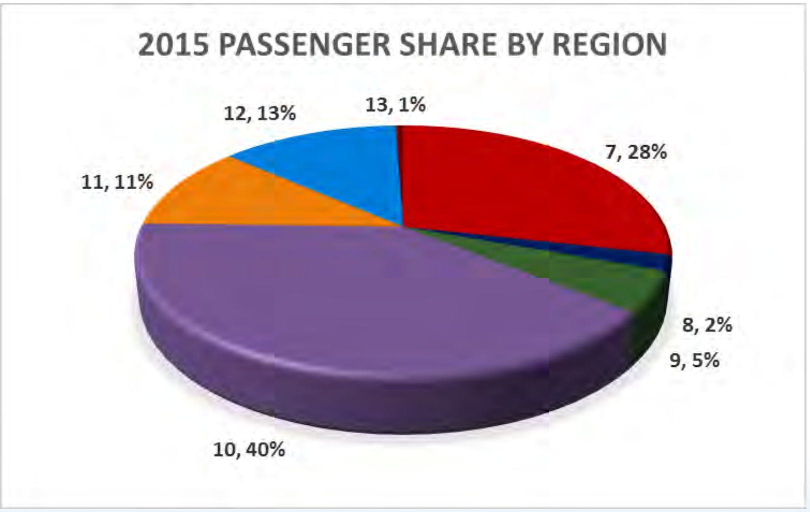




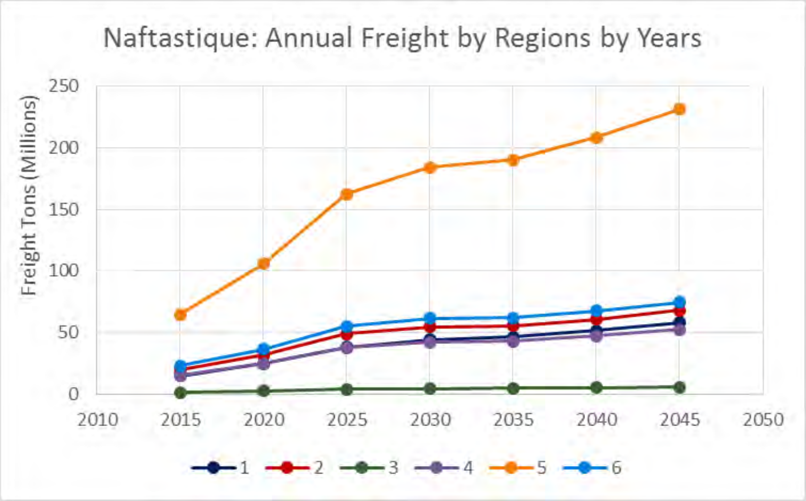
Freight & Passenger Share by Regions (US-Canada)

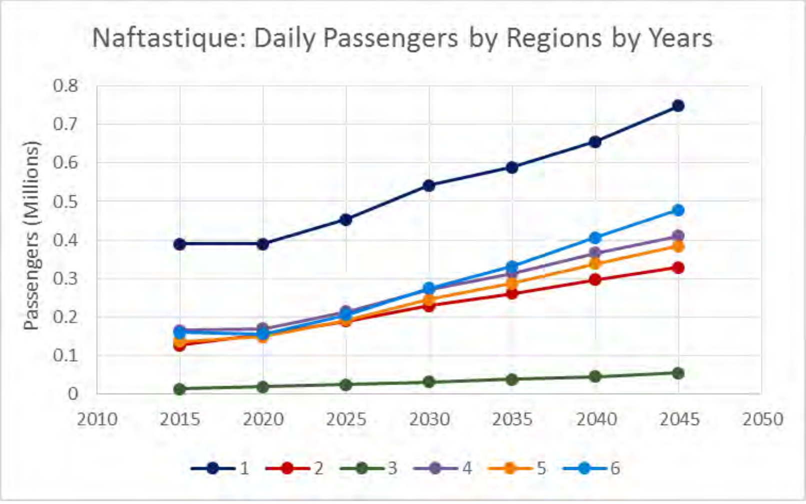


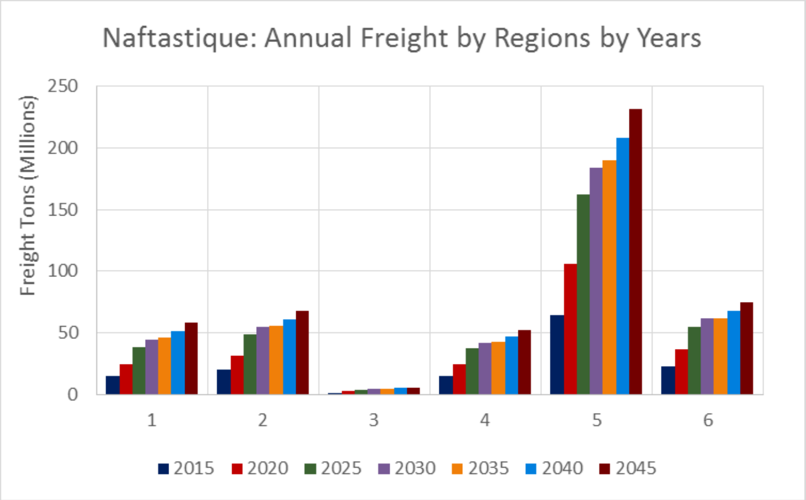


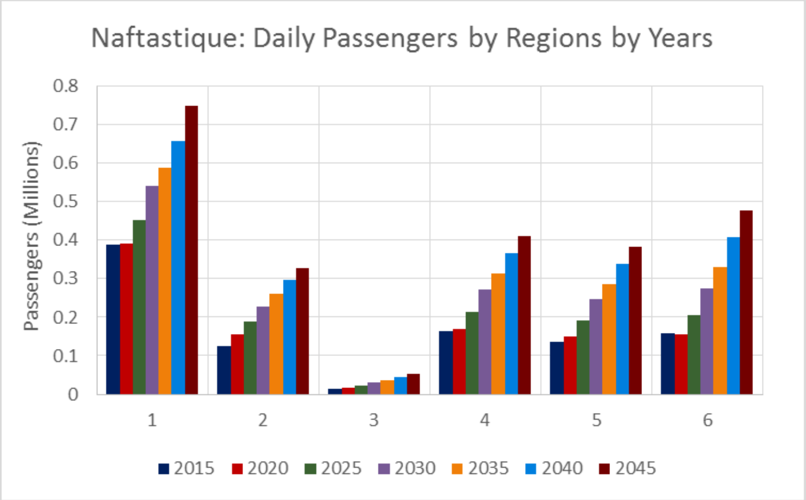


Scenarios by Regions by Years (US-MEX) NAFTASTIQUE

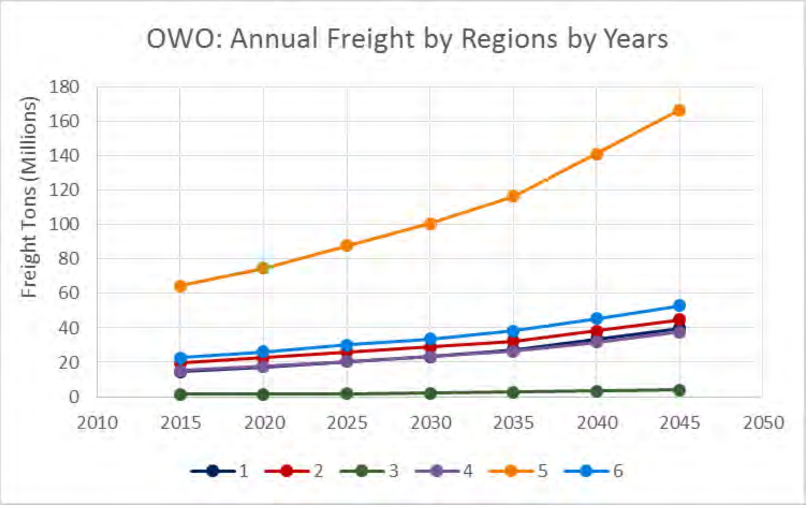


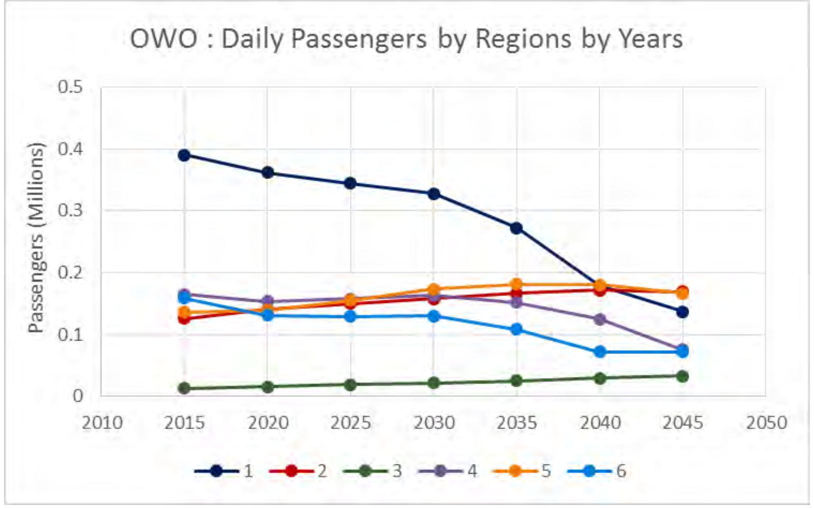


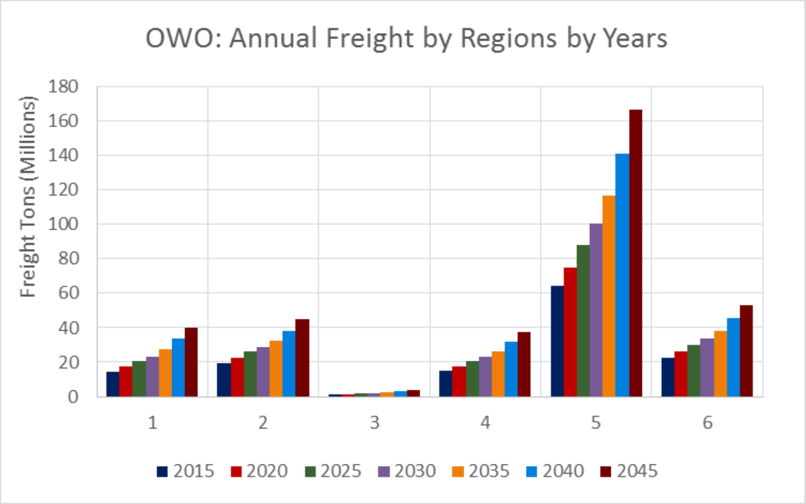


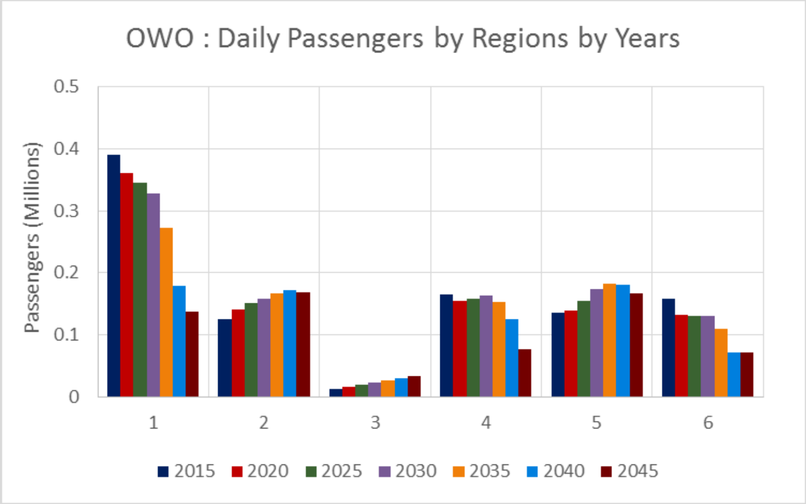


Scenarios by Regions by Years (US-MEX) One World Order

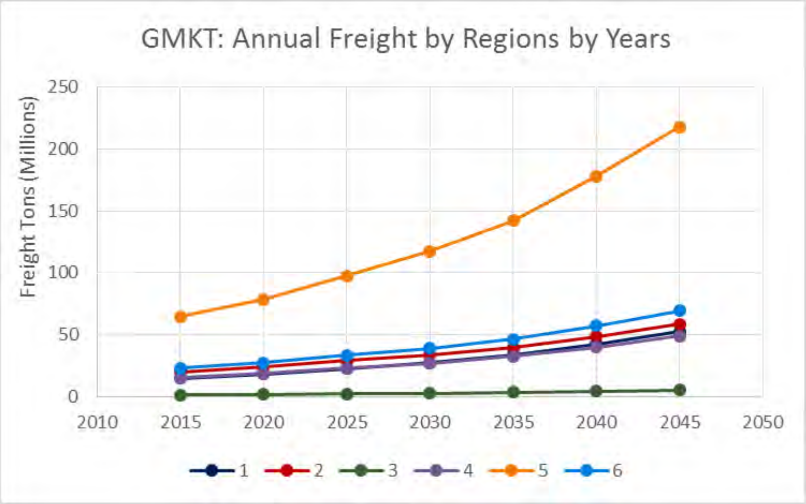


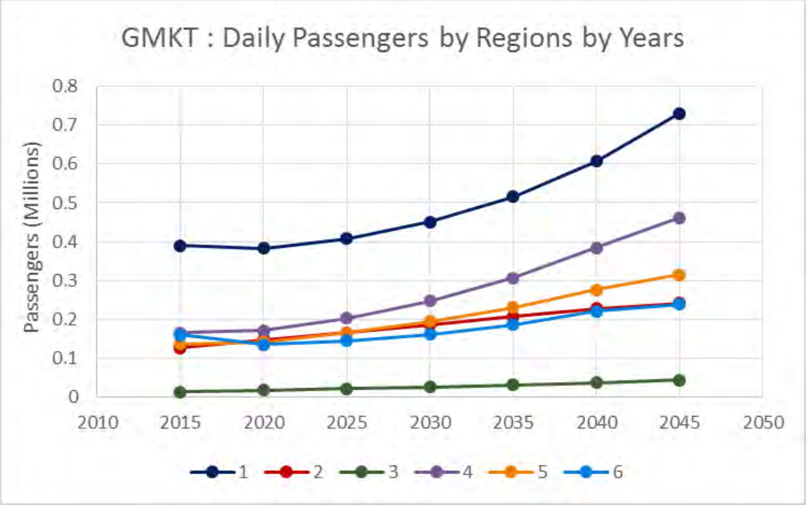


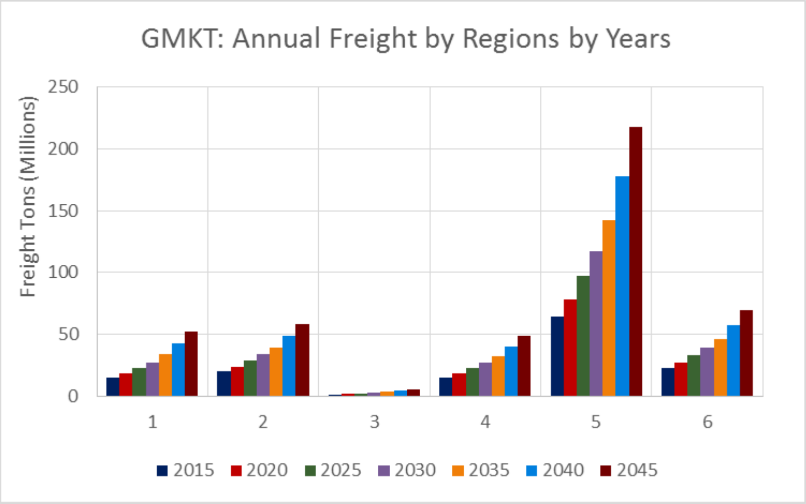


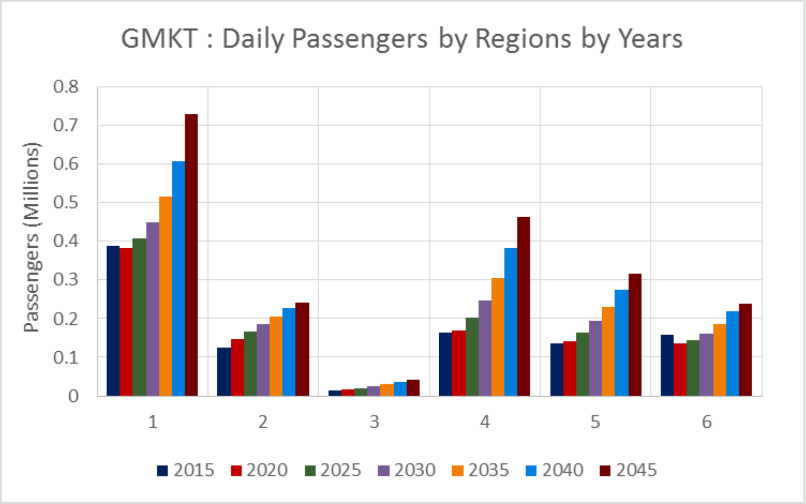


Scenarios by Regions by Years (US-MEX) Global Marketplace

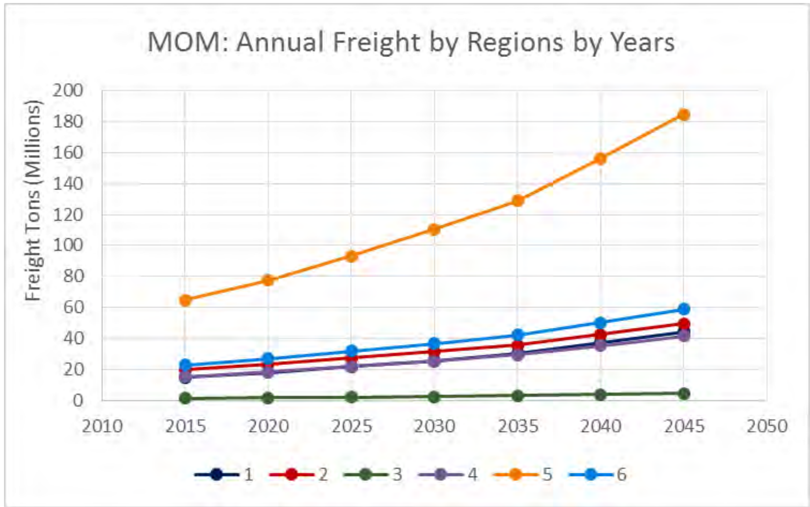


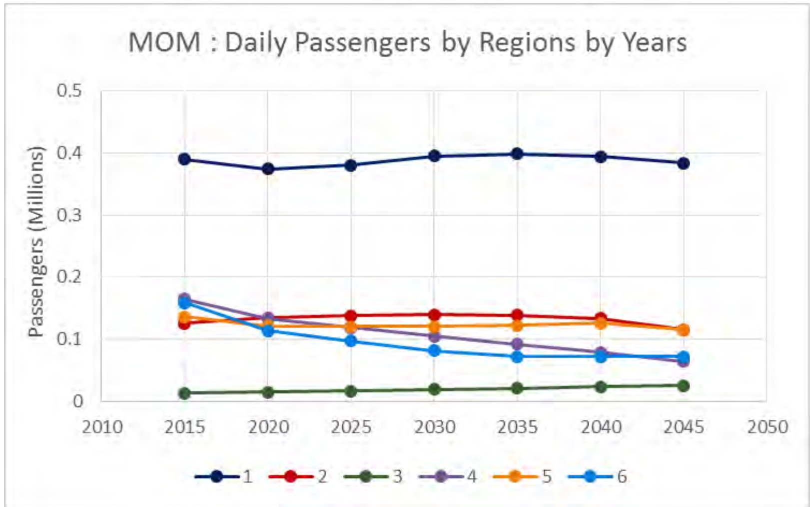


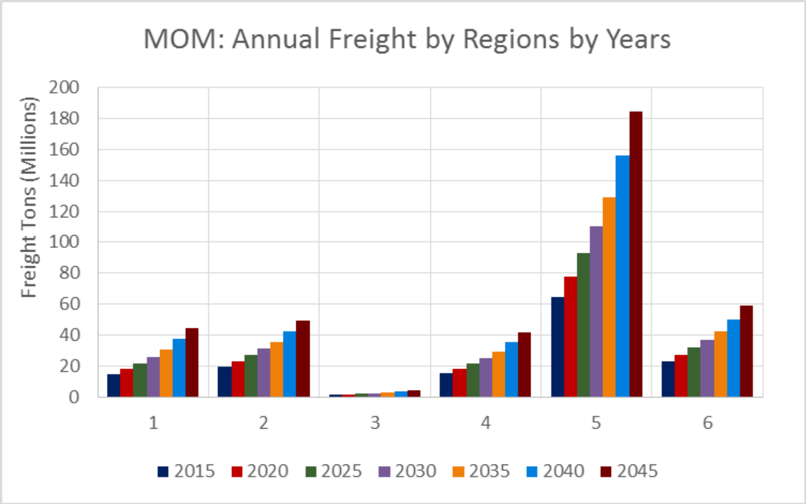


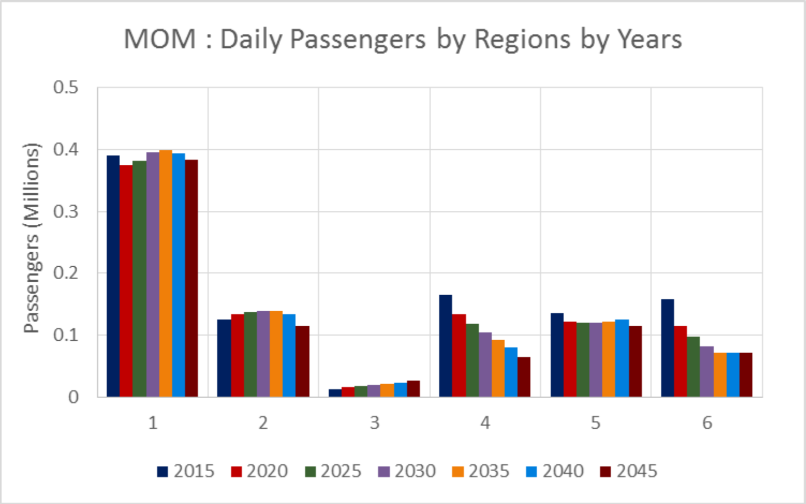


Scenarios by Regions by Years (US-MEX) Millions of Markets

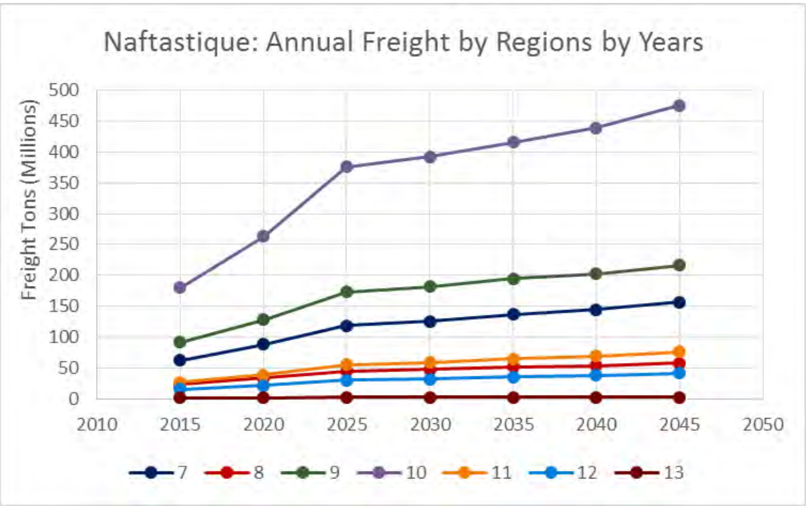


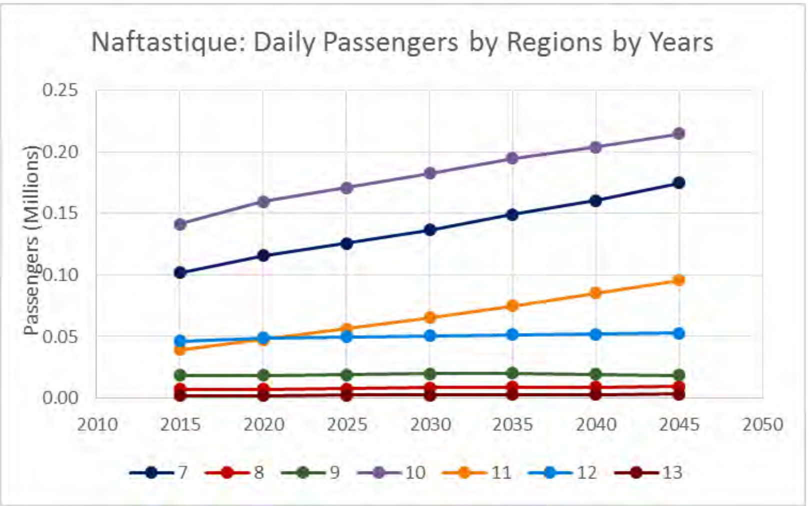


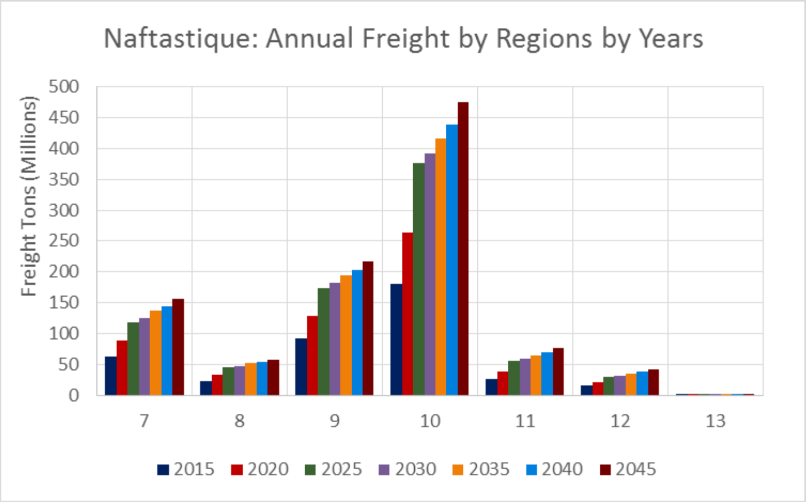


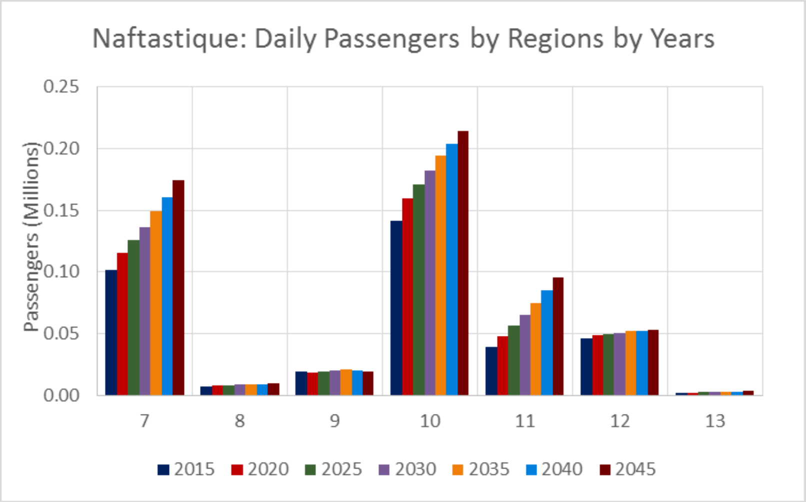


Scenarios by Regions by Years (US-CAN) NAFTASTIQUE

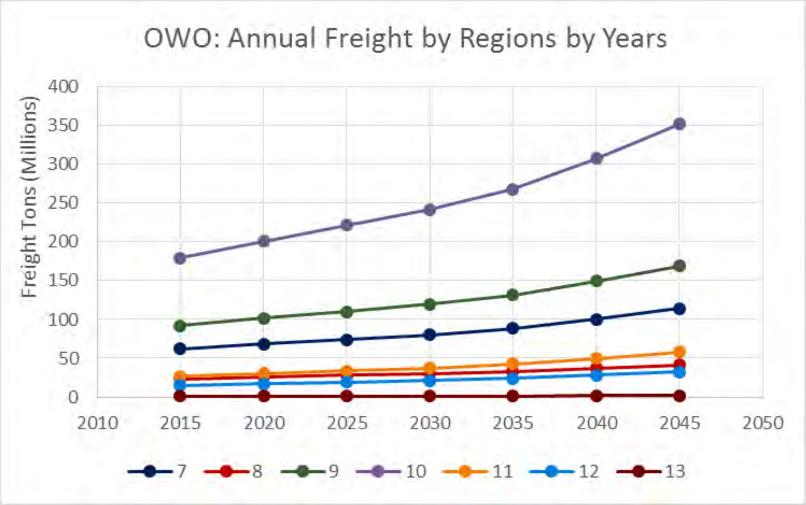


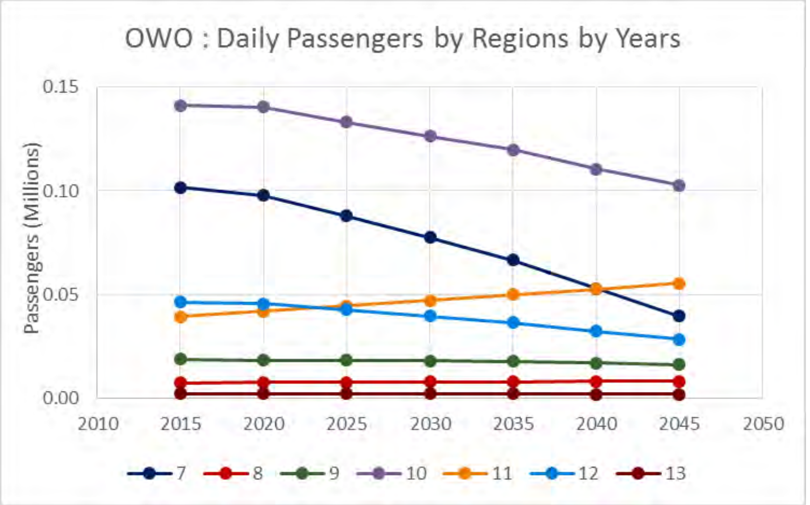


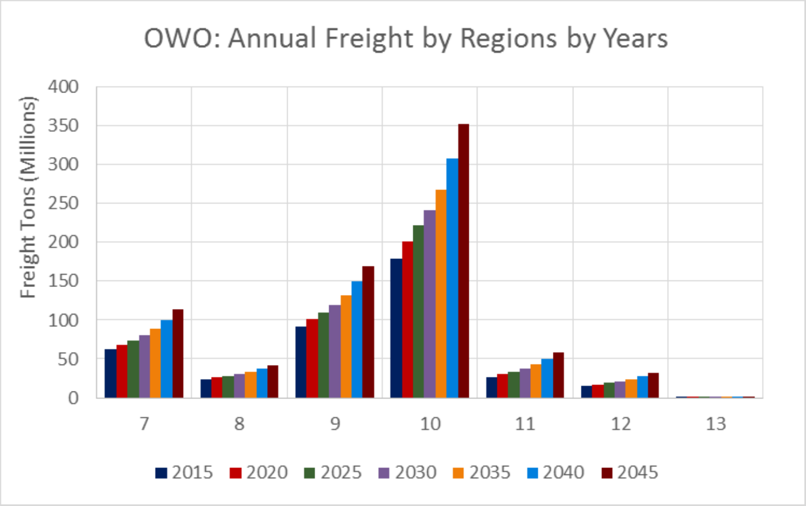


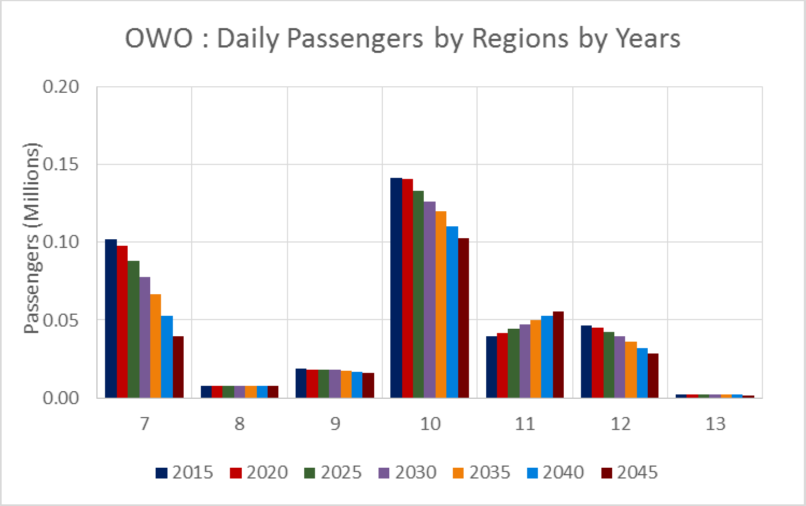


Scenarios by Regions by Years (US-CAN) One World Order

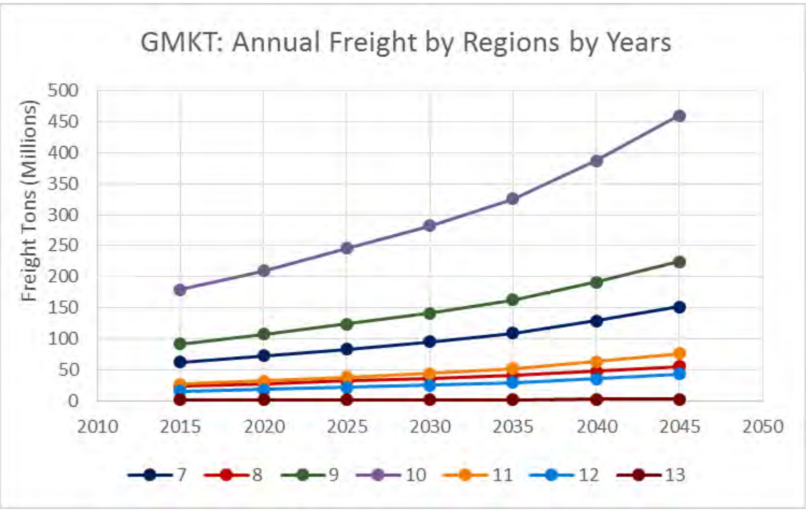


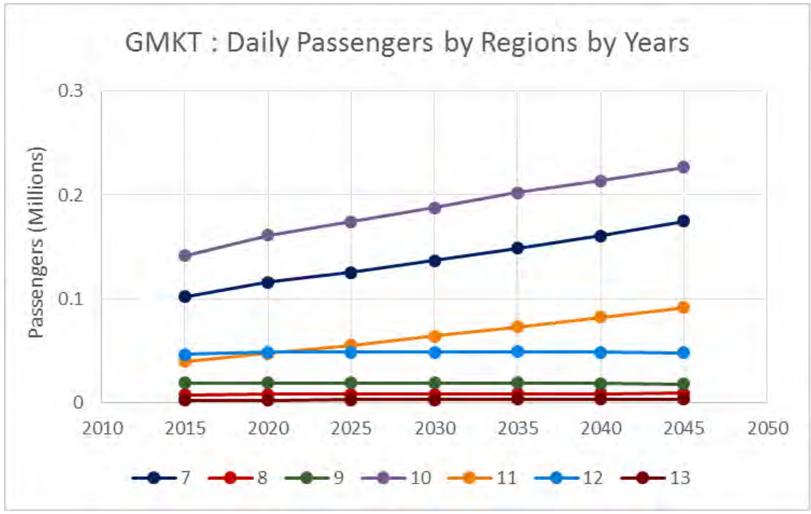


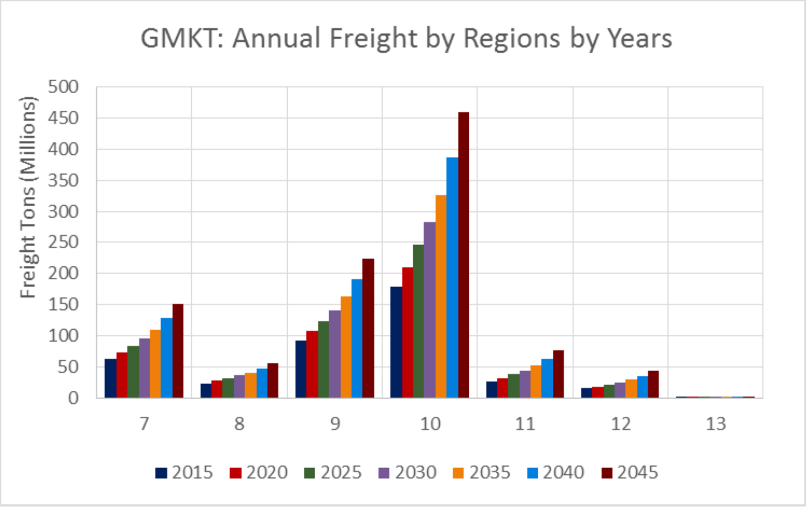


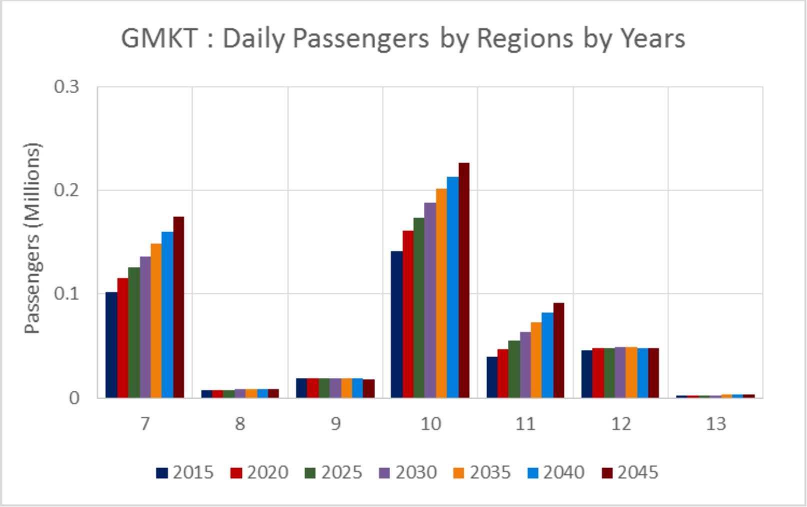


Scenarios by Regions by Years (US-CAN) Global Marketplace

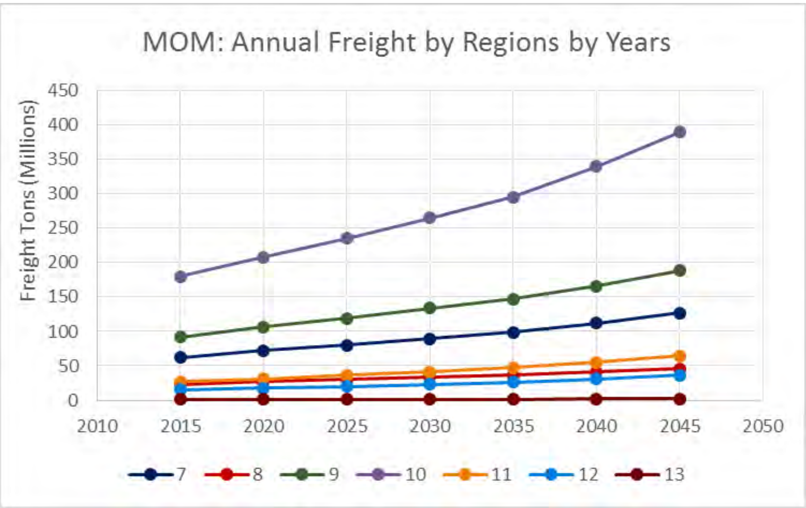


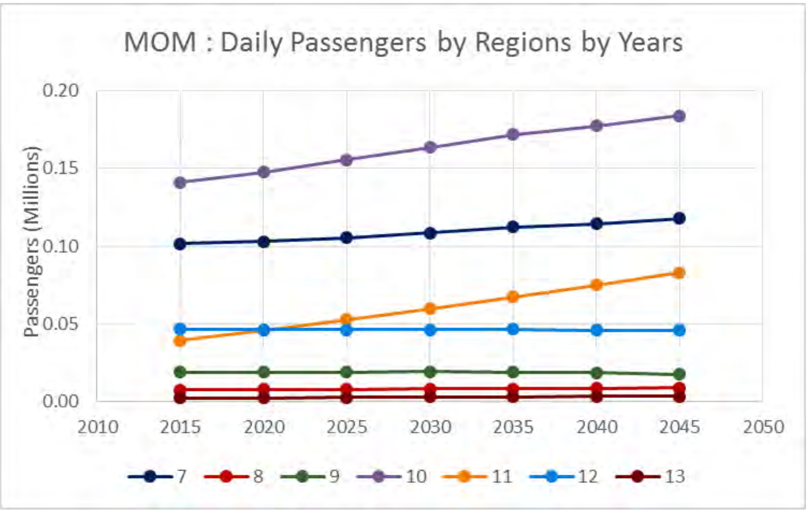


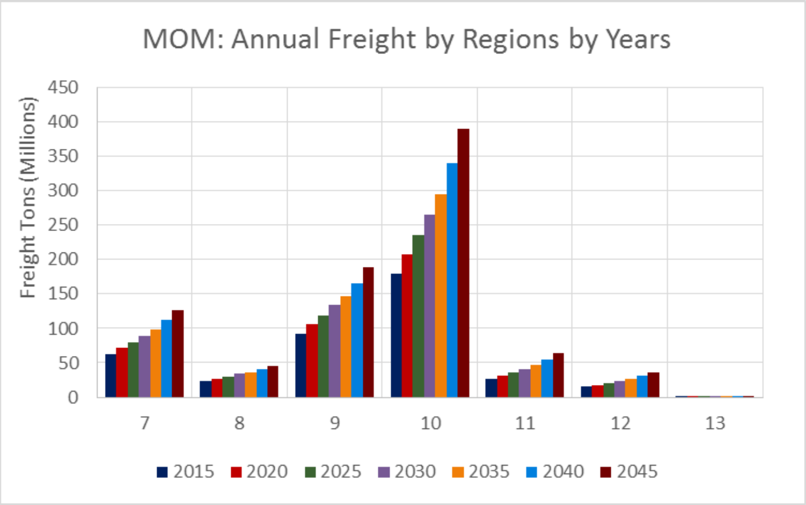


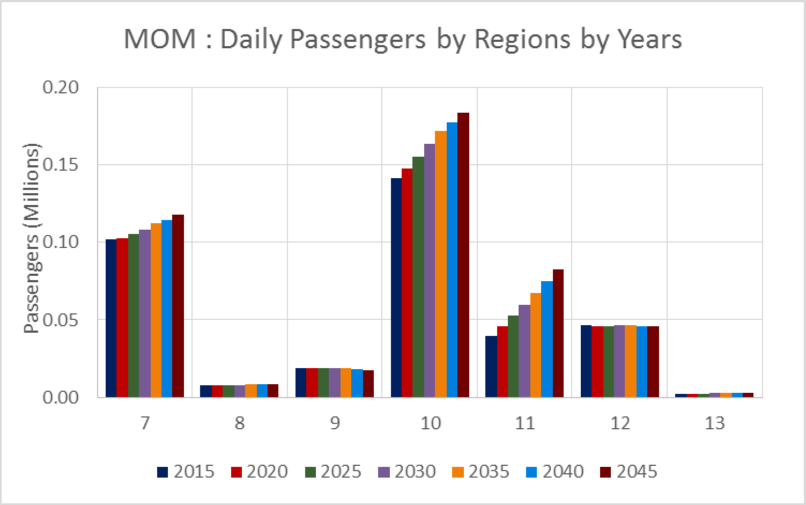


Scenarios by Regions by Years (US-CAN) Millions of Markets

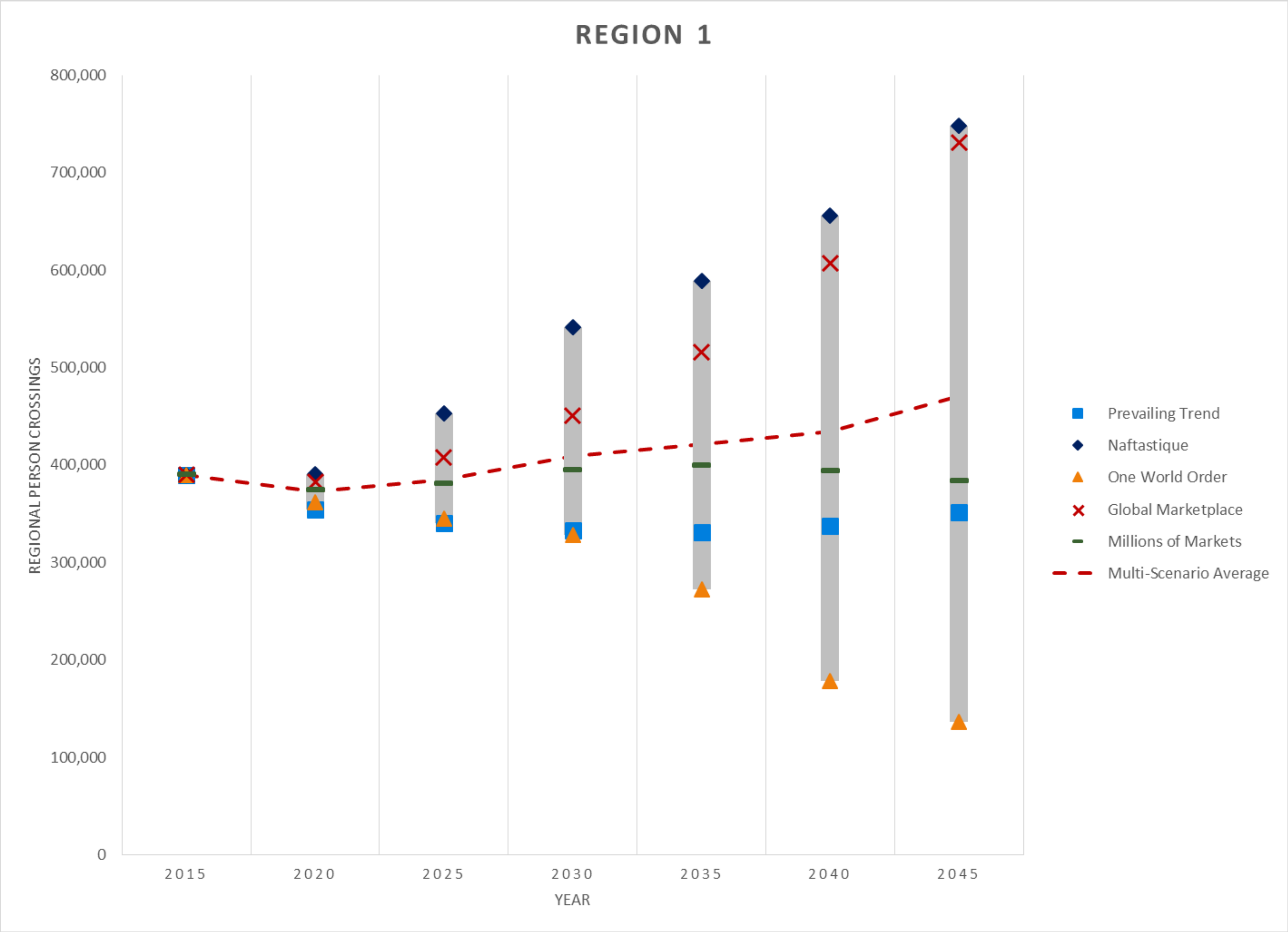




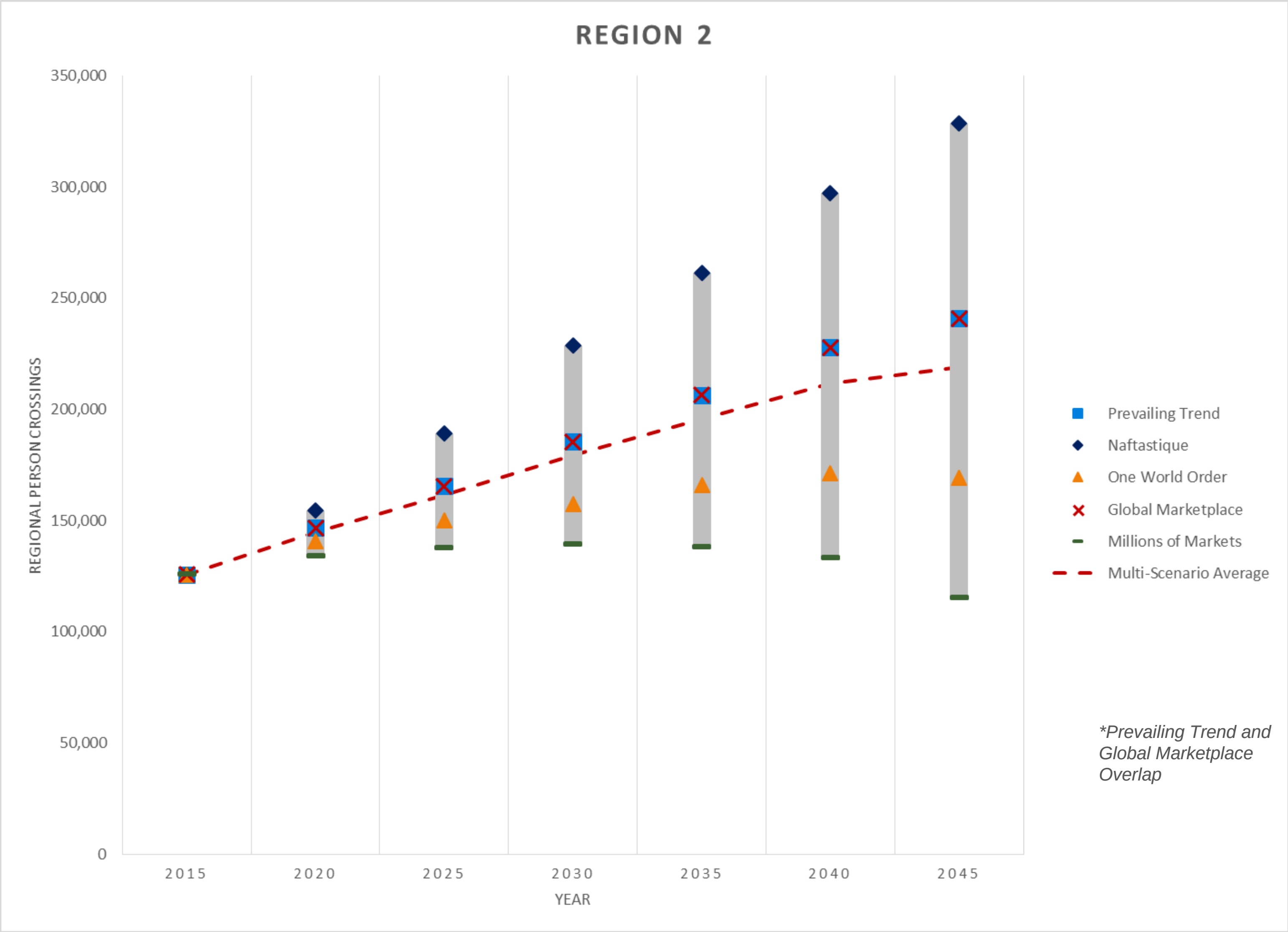




Multi-scenario Crossing Comparison Region 1

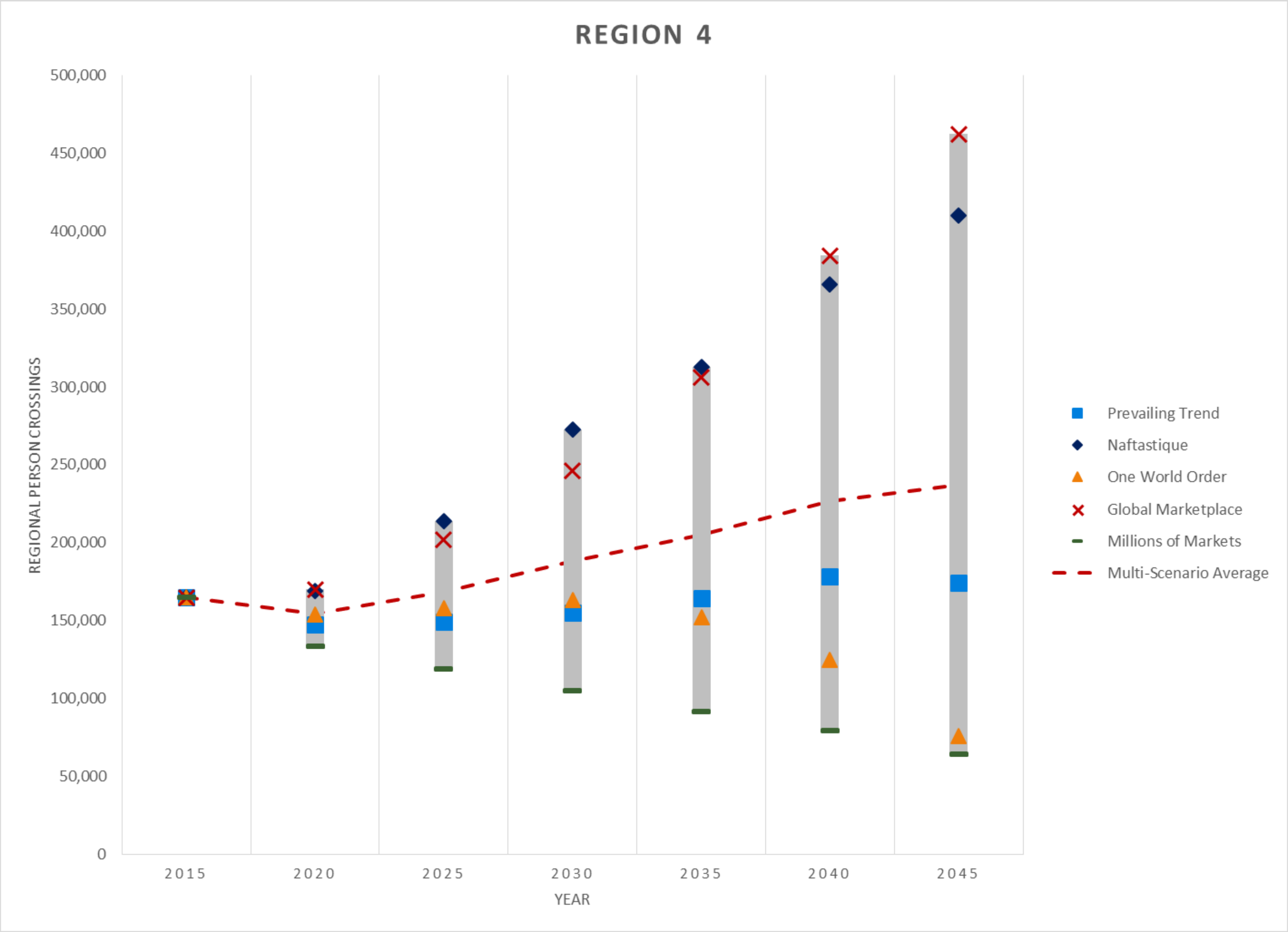


Multi-scenario Crossing Comparison Region 2

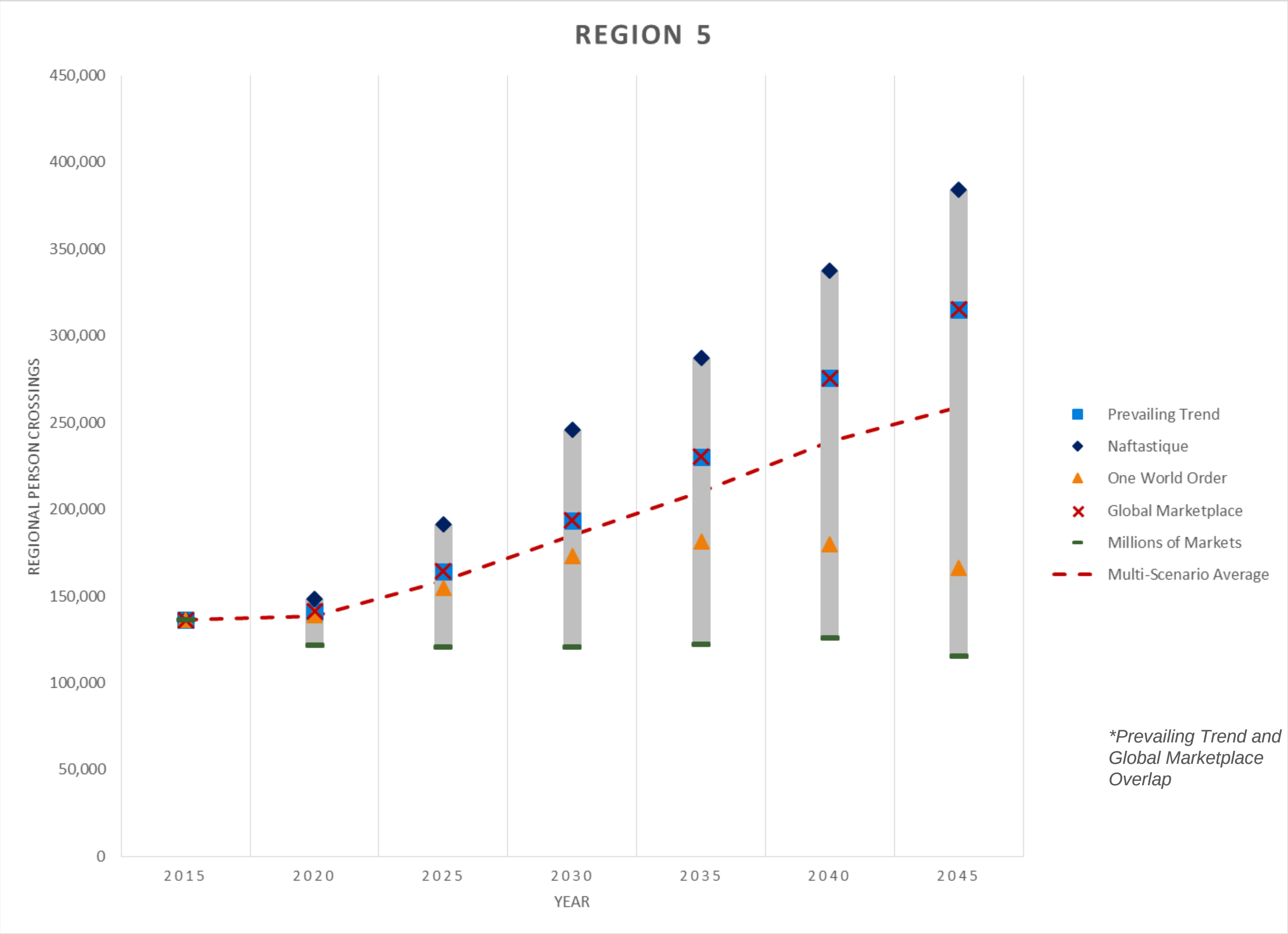


Multi-scenario Crossing Comparison Region 3

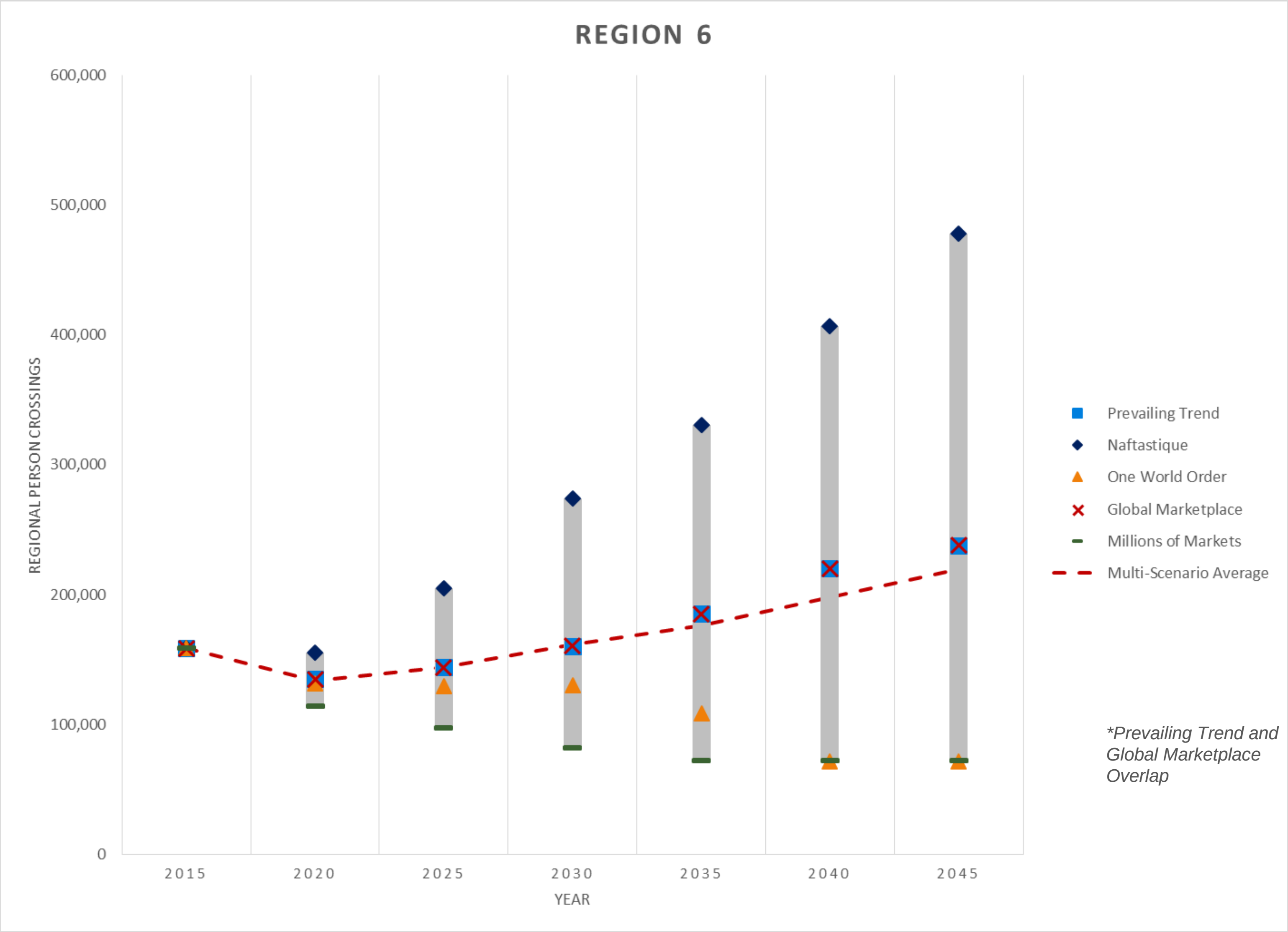
Multi-scenario Crossing Comparison Region 4



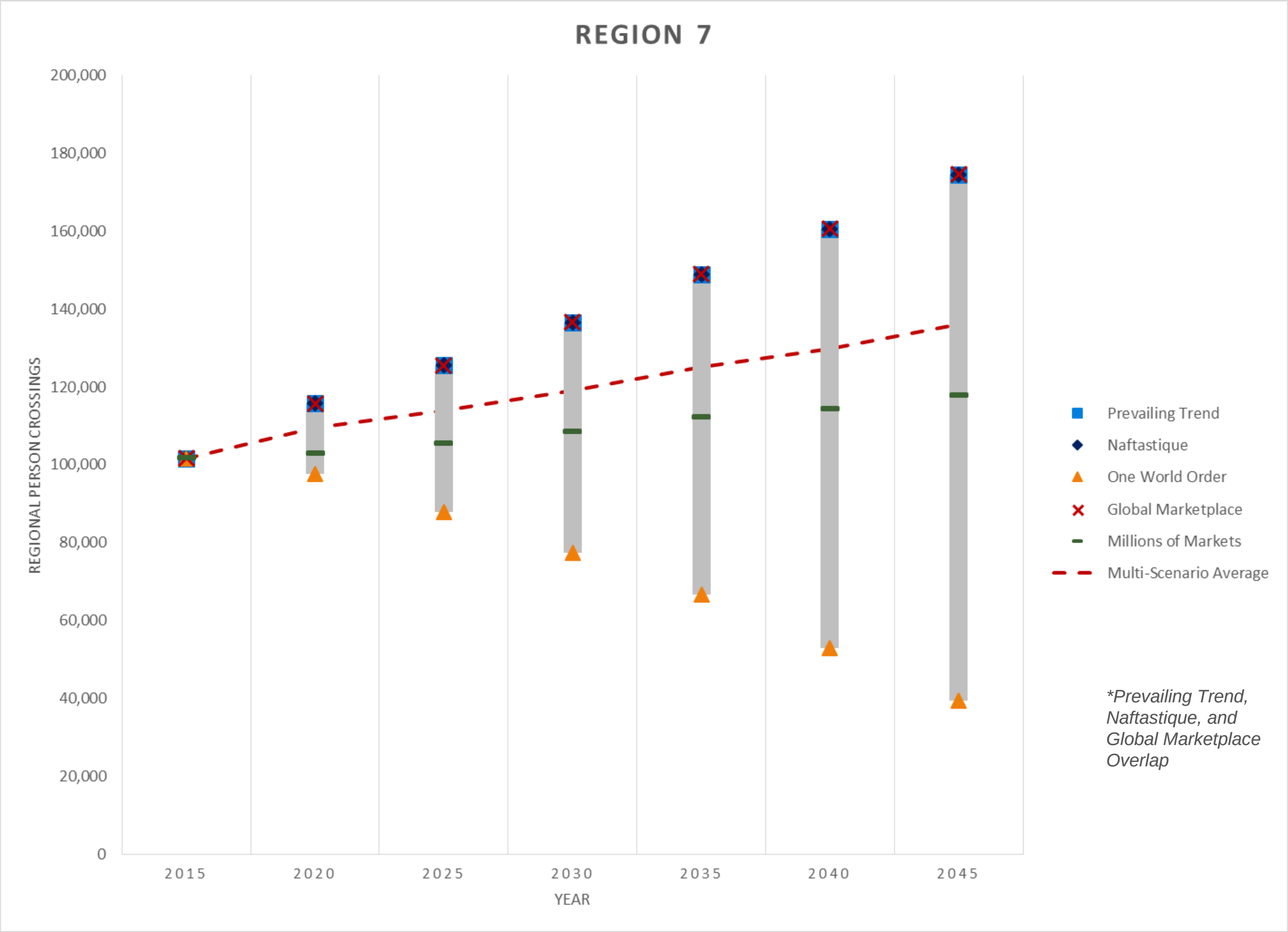
Multi-scenario Crossing Comparison Region 5



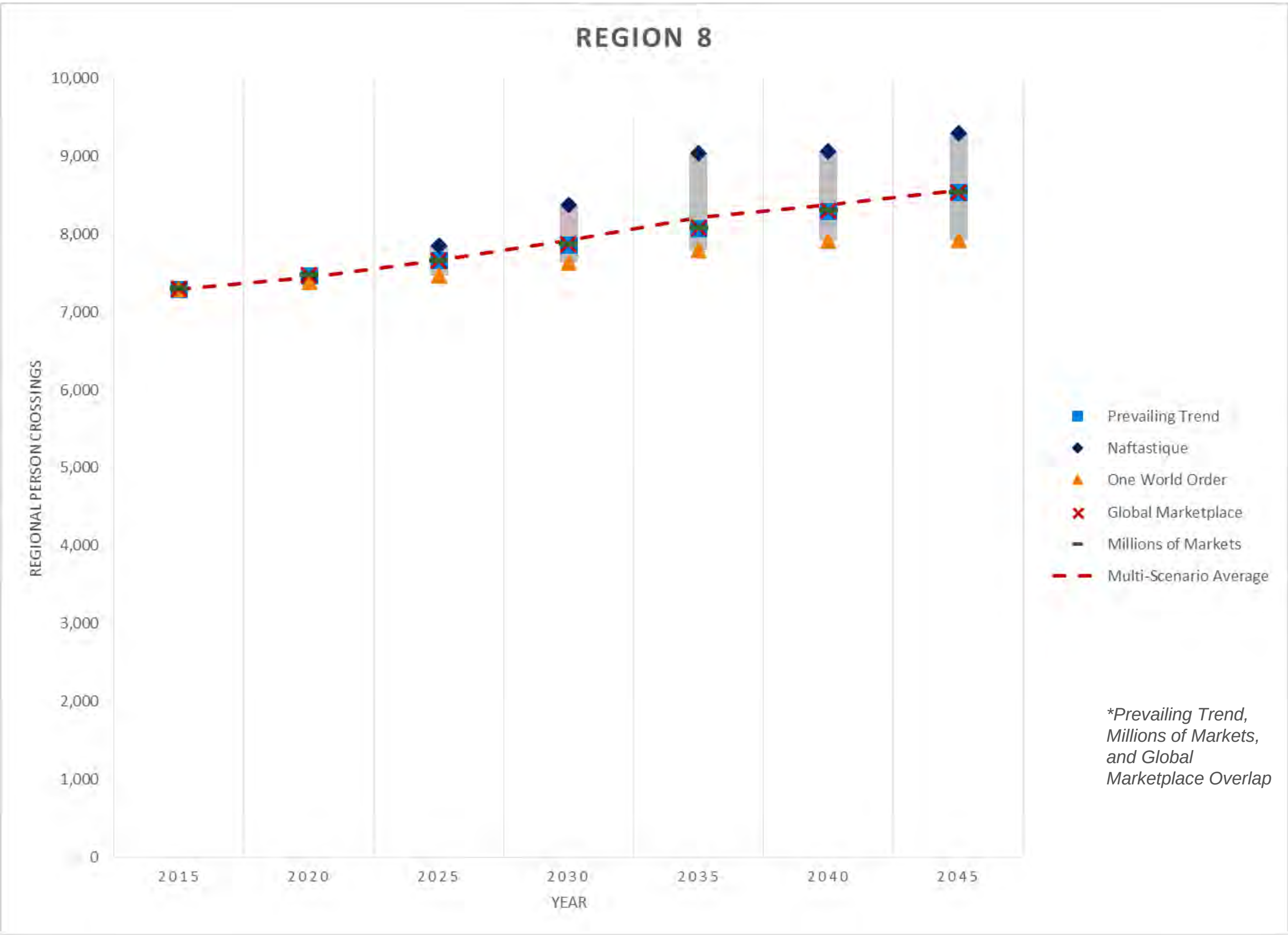
Multi-scenario Crossing Comparison Region 6



Multi-scenario Crossing Comparison Region 7

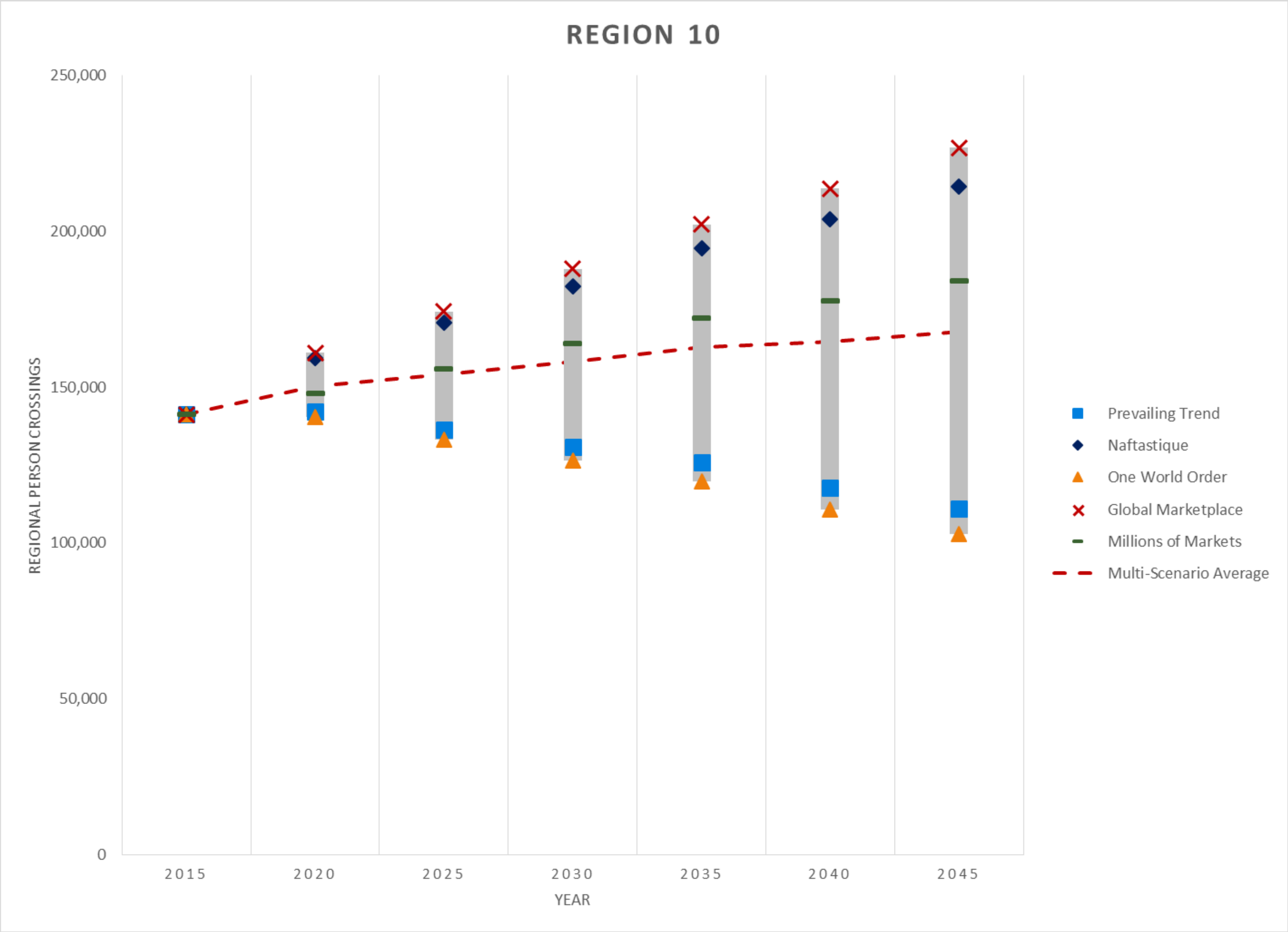


Multi-scenario Crossing Comparison Region 8

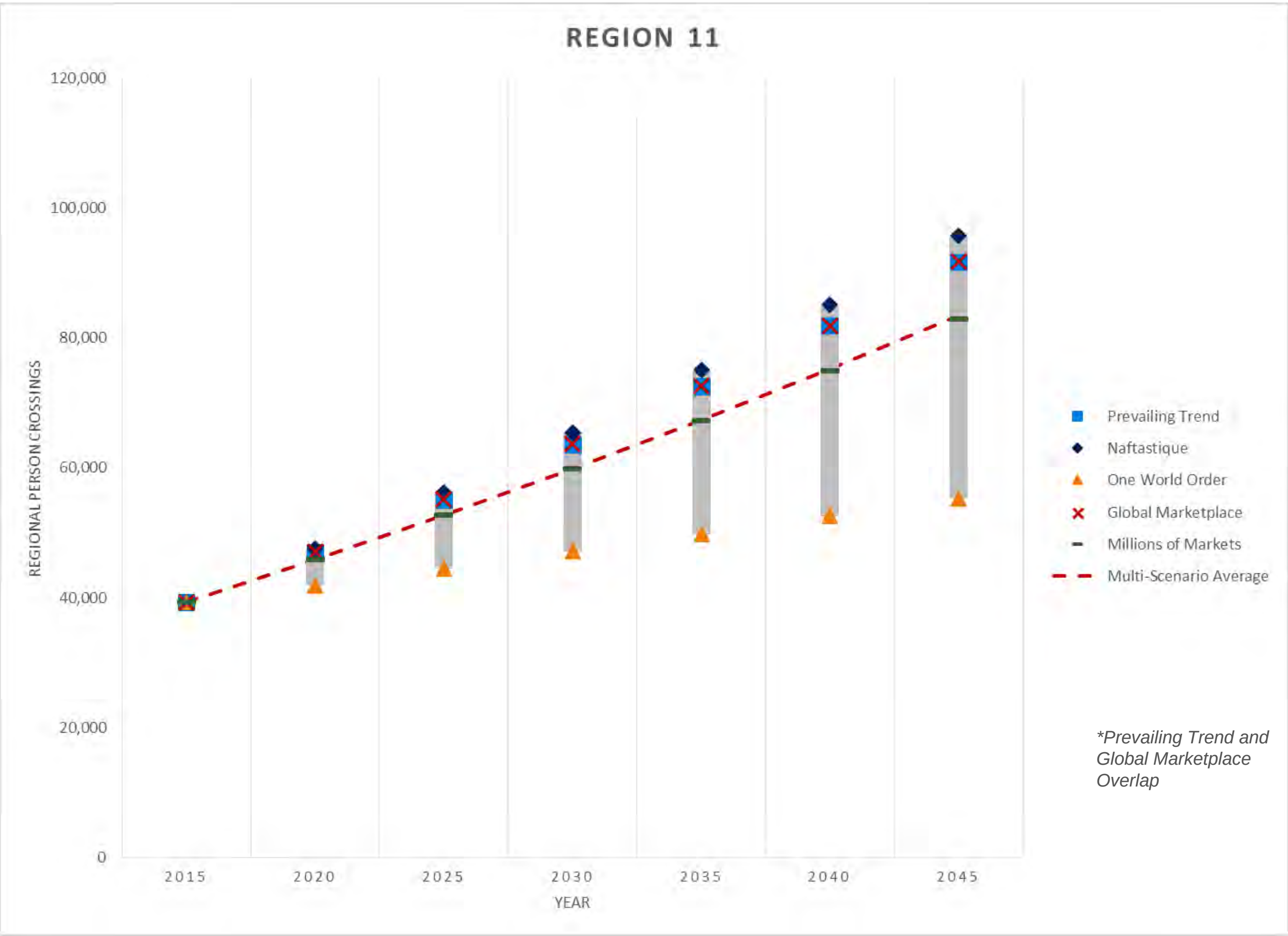


Multi-scenario Crossing Comparison Region 9

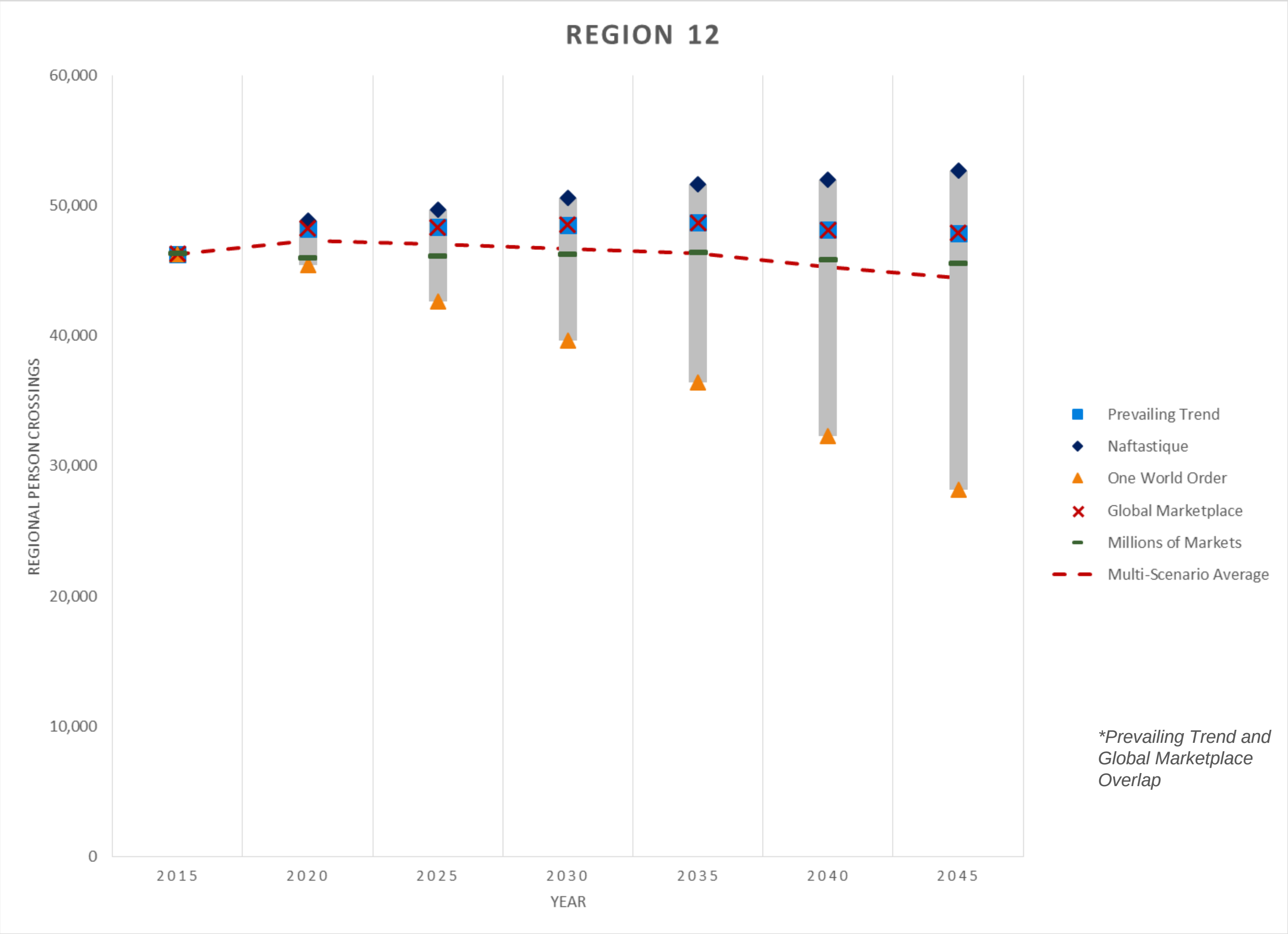
Multi-scenario Crossing Comparison Region 10



Multi-scenario Crossing Comparison Region 11

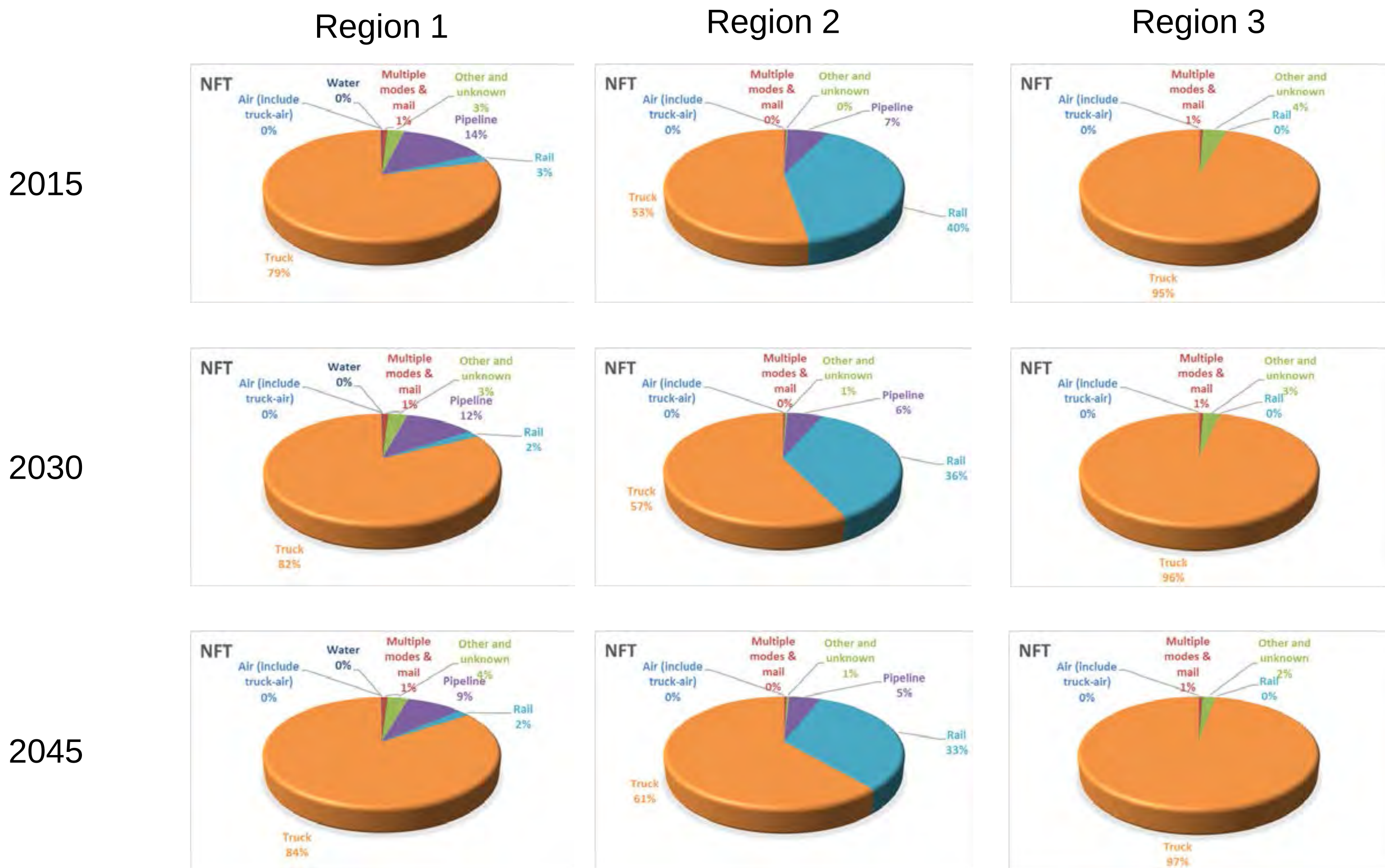


Multi-scenario Crossing Comparison Region 12



Multi-scenario Crossing Comparison Region 13

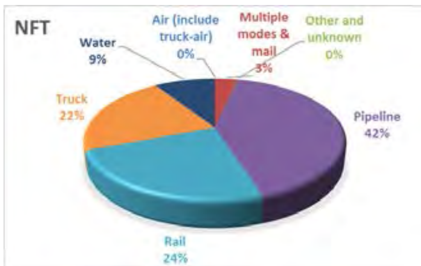
Freight Modal Share by Regions Example Naftastique

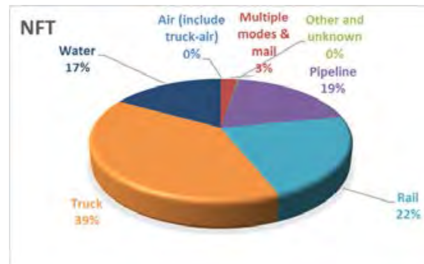


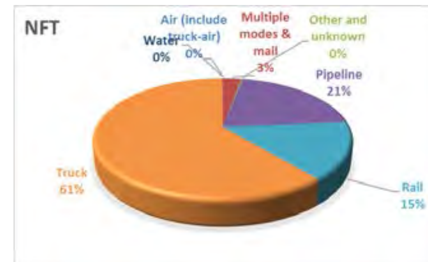
Freight Modal Share by Regions Example Naftastique

Region 7 | Region 10 | Region 12

2015







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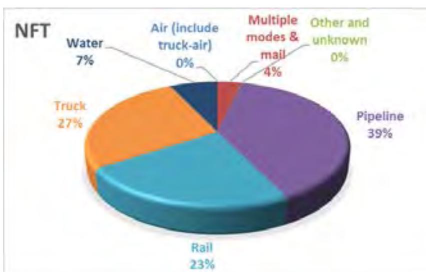

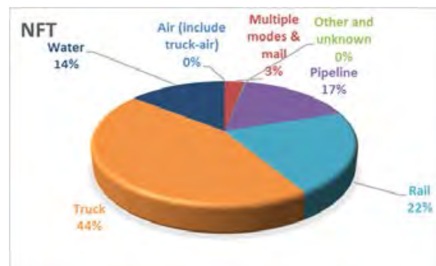

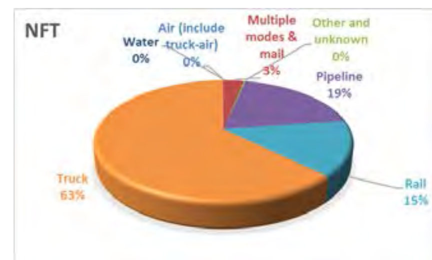

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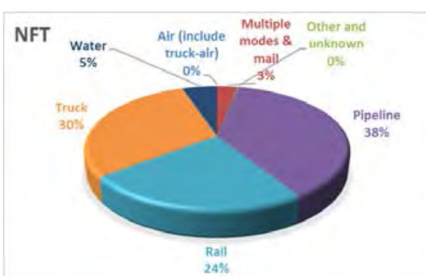
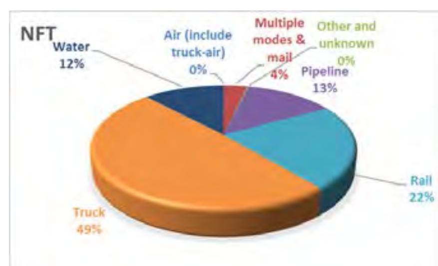
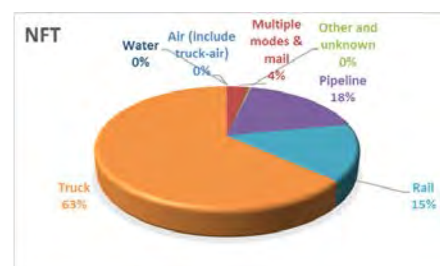
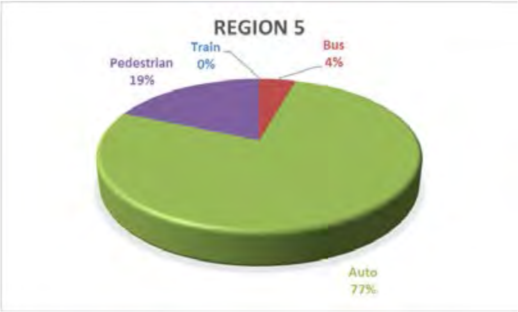
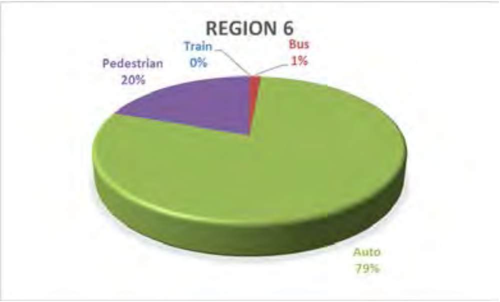




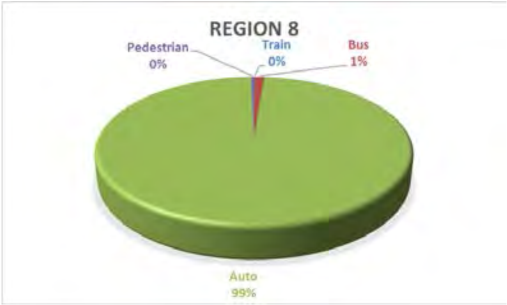


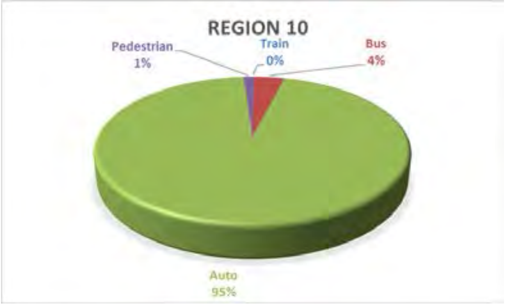
Passenger Mode Share by Regions Example Naftastique





Passenger Mode Share by Regions Example Naftastique





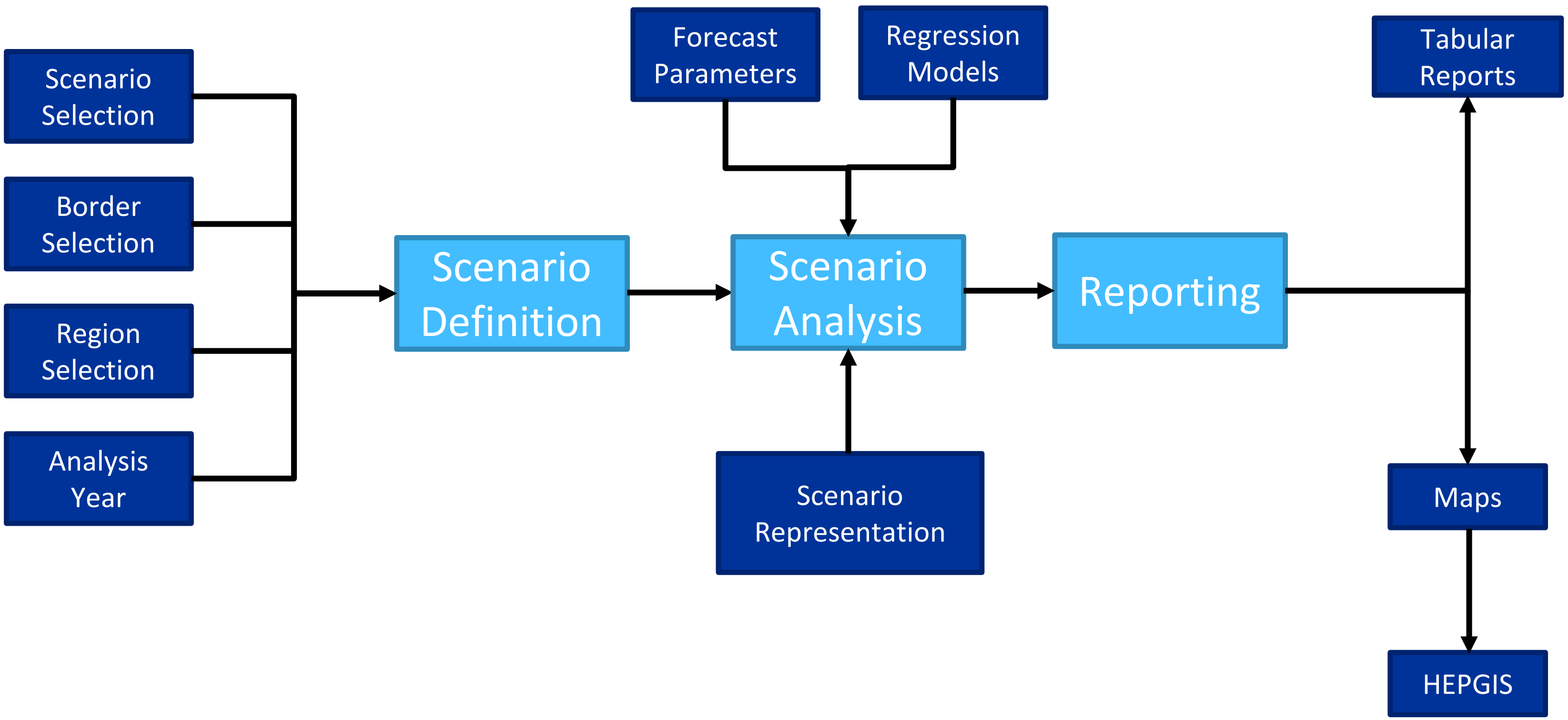
Conclusive Comments

- Framework facilitates application of Scenario Analysis as a tool for planning purposes
- Results vary from aggregate/macro level to detailed/micro level information
- Passenger model is implemented as a spreadsheet
- Freight models are Scenario-specific Access Databases

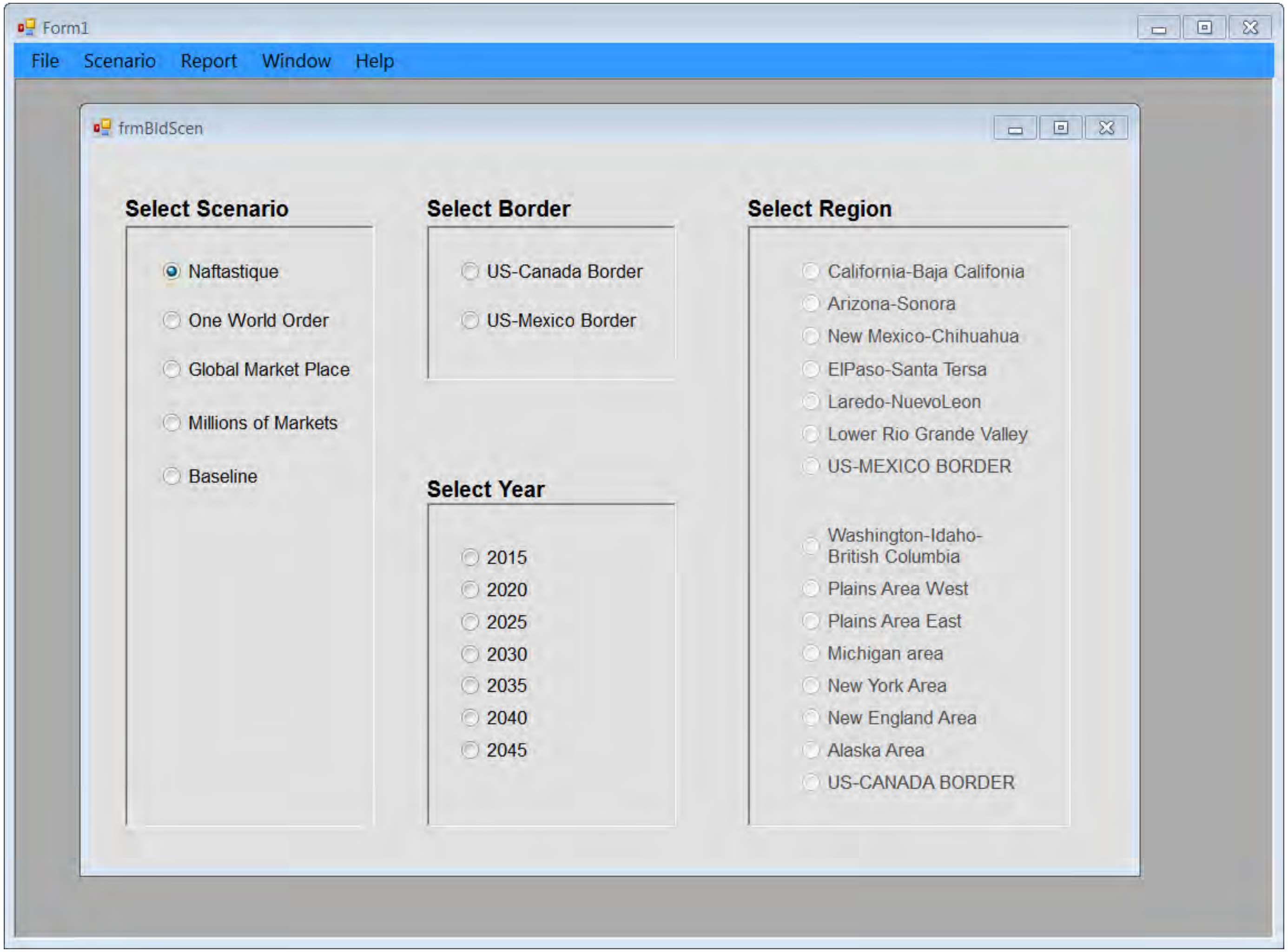
Need for System Integration

- All components need to be brought into a common framework
- A reusable tool/framework that integrates the pieces together is being developed
- Facilitate analysis and development of other scenarios
- Generate formatted reports for sharing of results

Conceptual Tool Structure



User Interface



Next Steps

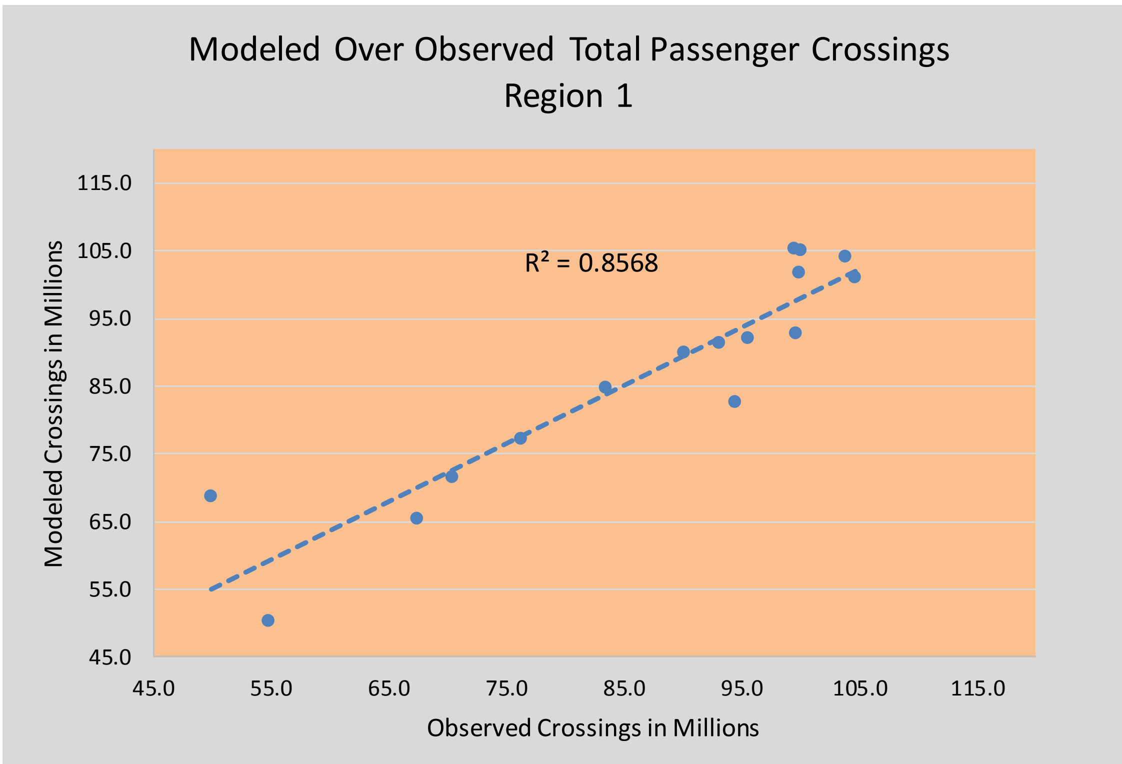
- Incorporate feedback from today’s meeting
- Finalize analytical framework
- Finalize user framework/tool

THANK YOU!

H. REGRESSION ANALYSIS OUTPUTS

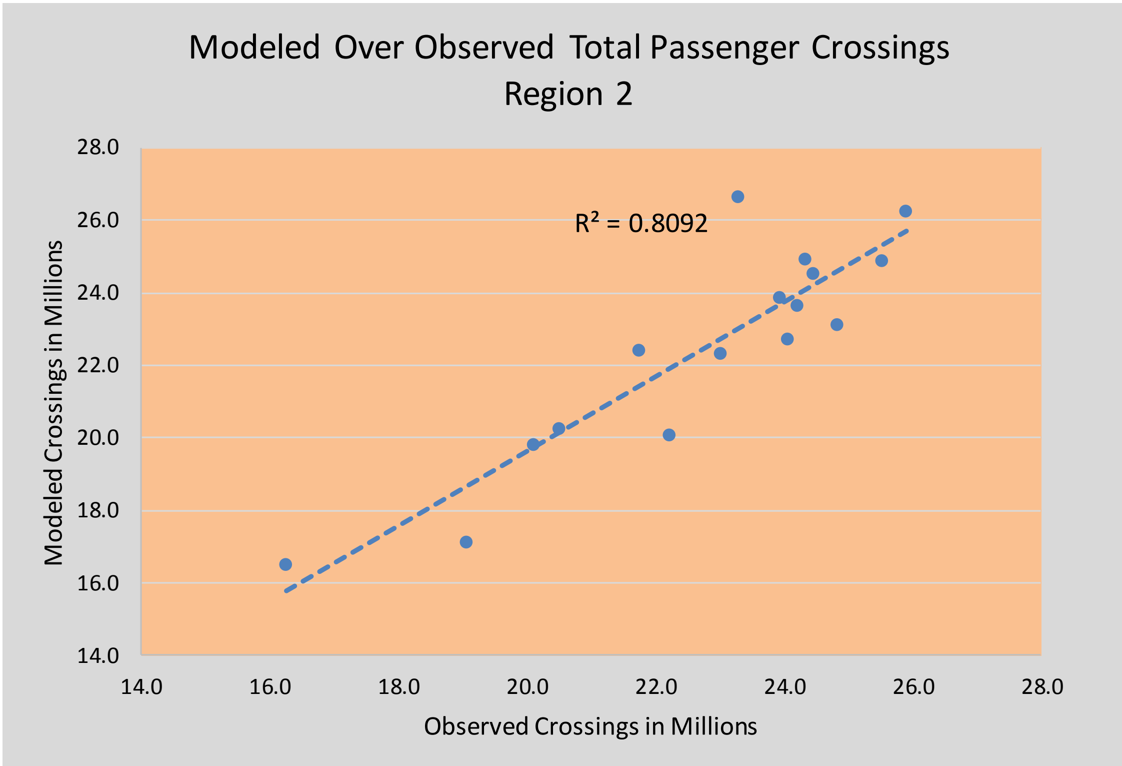
H.1 REGION 1: CALIFORNIA – BAJA CALIFORNIA

This figure shows a scatterplot of the modeled border crossings over the observed border crossings from the regression model for Border Region 1: California-Baja California. It reports an R^2 of 0.8568.



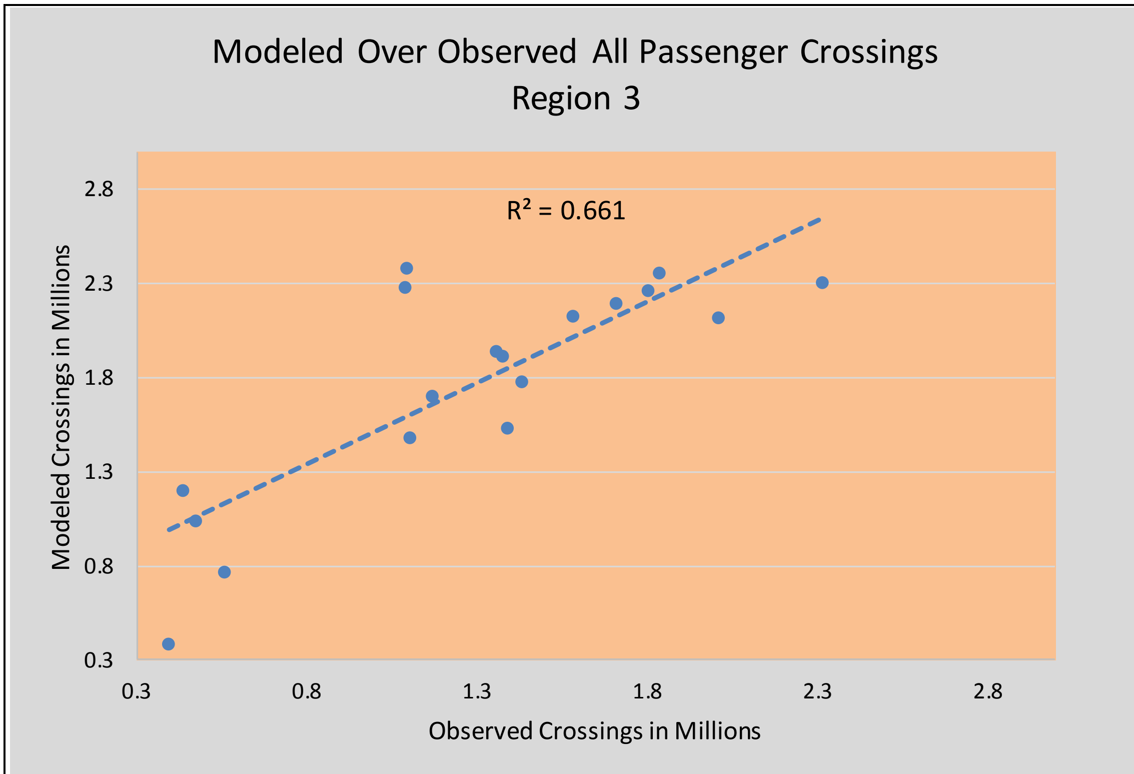

```
Coefficients:
              Estimate Std. Error t value Pr(>|t|)
(Intercept)  1.058e+08  2.138e+07   4.951 0.000336 ***
UnemM       -1.056e+07  1.920e+06  -5.501 0.000136 ***
GRP_US       2.278e+02  1.248e+02   1.826 0.092797 .
Gas_CA      -1.558e+07  6.337e+06  -2.459 0.030080 *
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

H.2 REGION 2: ARIZONA – SONORA



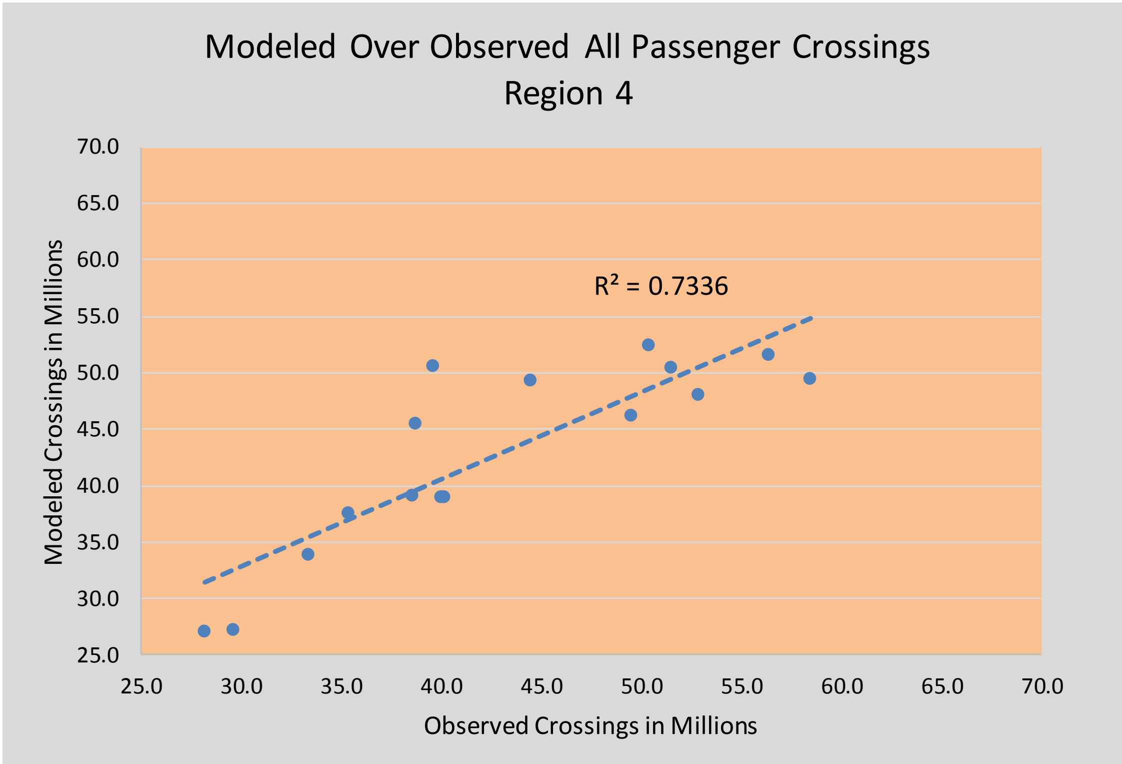

```
Coefficients:
              Estimate Std. Error t value Pr(>|t|)
(Intercept) -7.224e+06  1.340e+07  -0.539  0.59891
GRP_US       1.218e+02  4.601e+01   2.647  0.02014 *
UnemM       -1.948e+06  4.562e+05  -4.271  0.00091 ***
MXDUSD       1.618e+08  5.339e+07   3.031  0.00965 **
Crude_DpB   -7.650e+04  3.191e+04  -2.397  0.03226 *
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

H.3 REGION 3: NEW MEXICO – CHIHUAHUA



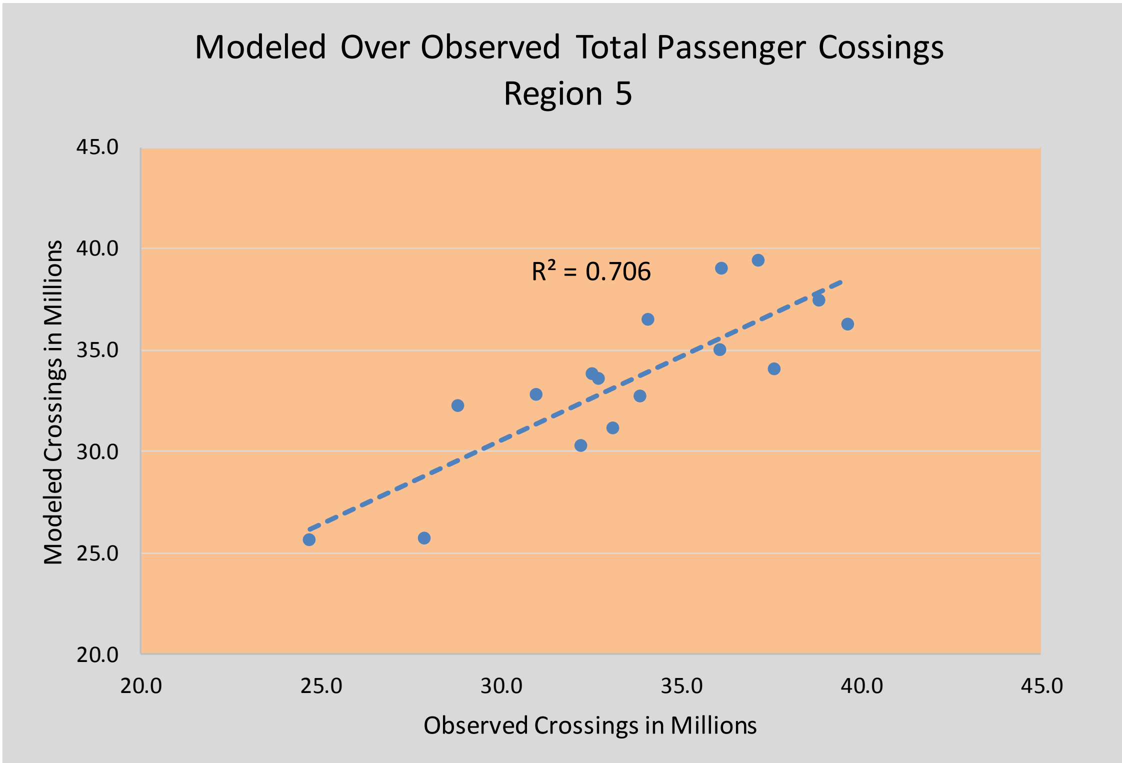

```
Coefficients:
              Estimate Std. Error t value Pr(>|t|)
(Intercept) -1.300e+06  5.705e+05  -2.278   0.0378 *
GRP_US       5.295e+02  7.425e+01   7.131 3.44e-06 ***
UnemM       -1.848e+05  6.517e+04  -2.836   0.0125 *
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

H.4 REGION 4: EL PASO – SANTA TERESA



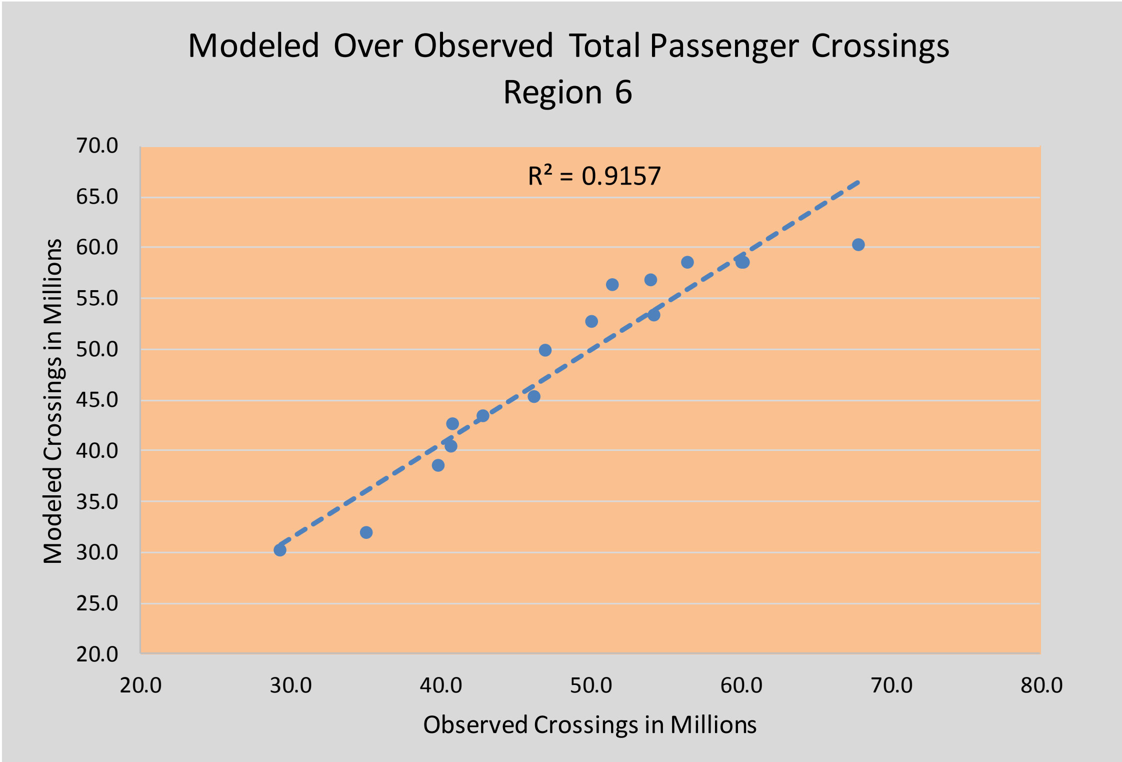

```
Coefficients:
         Estimate Std. Error t value Pr(>|t|)
Gas_TX -8.431e+06  4.064e+06  -2.075  0.06019 .
GRP_US  1.294e+03  4.155e+02   3.115  0.00894 **
UnemM  -5.191e+06  1.357e+06  -3.825  0.00242 **
MXDUSD  4.173e+08  6.549e+07   6.372 3.55e-05 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

H.5 REGION 5: LAREDO – NUEVO LEON



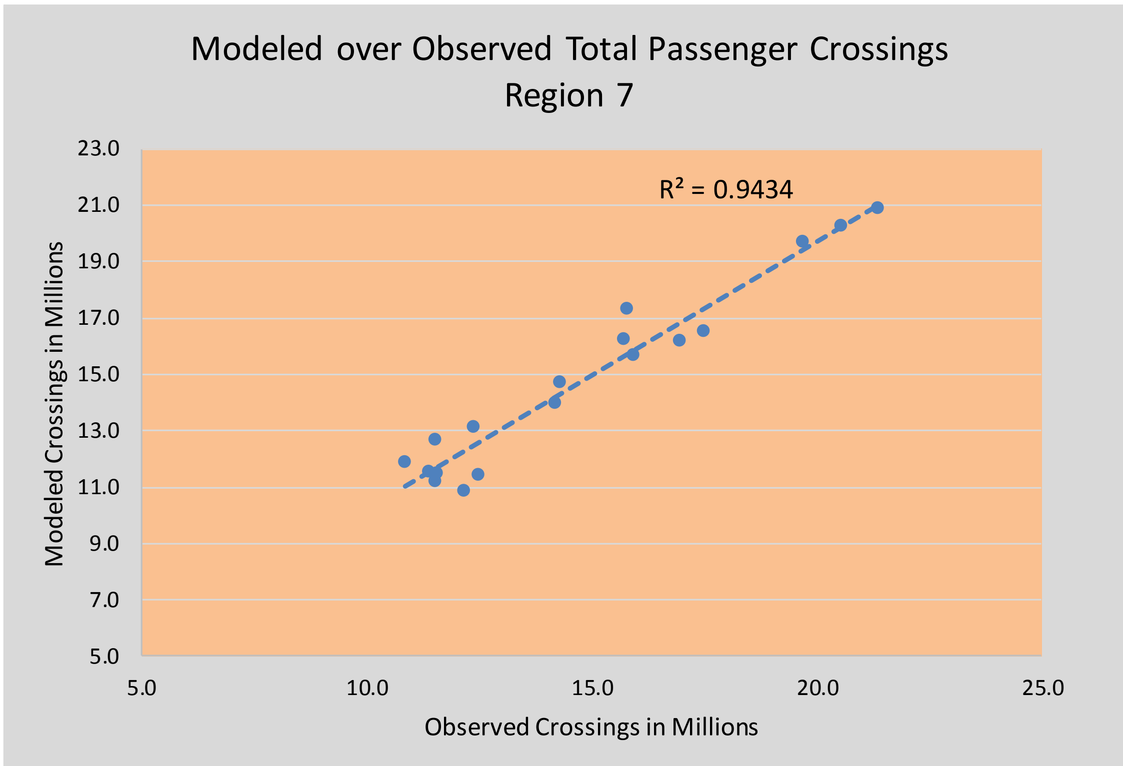

```
Coefficients:
         Estimate Std. Error t value Pr(>|t|)
Gas_TX -6.133e+06  2.056e+06  -2.983   0.0114 *
GRP_US  2.767e+03  4.208e+02   6.577 2.63e-05 ***
UnemM  -3.882e+06  6.441e+05  -6.026 5.97e-05 ***
MXDUSD  2.842e+08  2.670e+07  10.644 1.82e-07 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

H.6 REGION 6: LOWER RIO GRANDE VALLEY



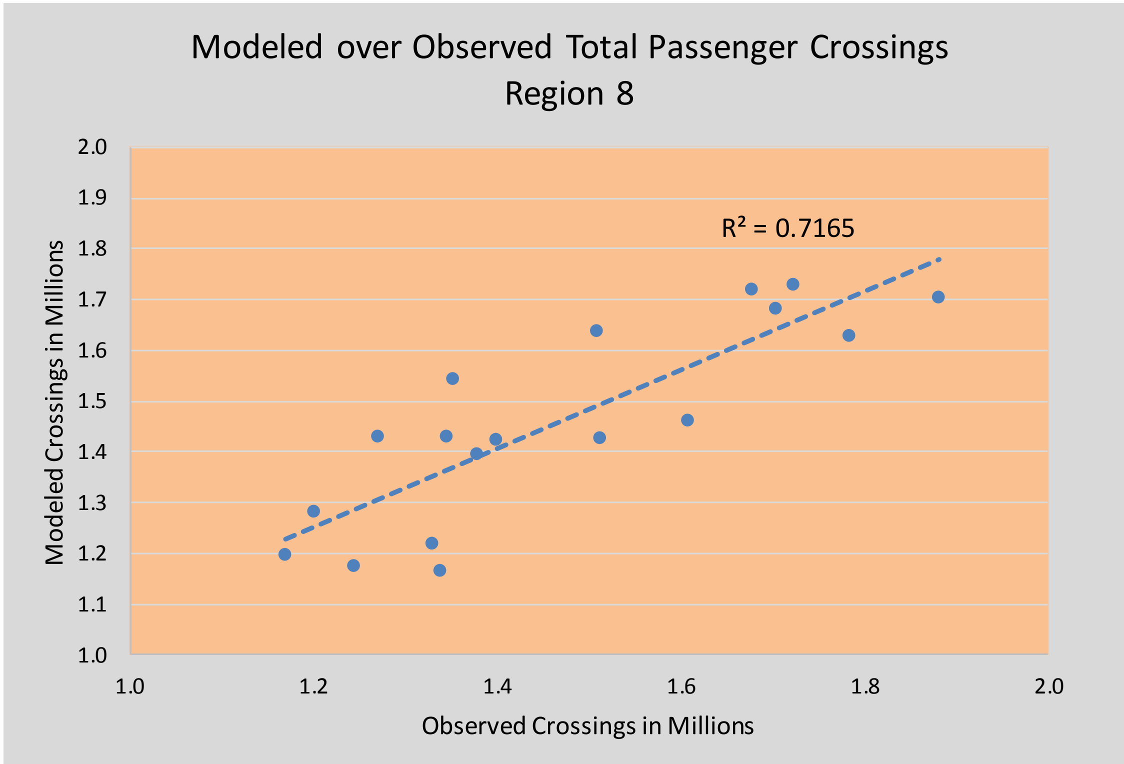

```
Coefficients:
              Estimate Std. Error t value Pr(>|t|)
(Intercept) 98937938.8  3543923.5  27.918 2.40e-14 ***
GRP_US         -1782.0      123.2 -14.463 3.24e-10 ***
UnemM       -2918857.2   595322.9  -4.903 0.000191 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

H.7 REGION 7: WASHINGTON – IDAHO – BRITISH COLUMBIA




```
Coefficients:
              Estimate Std. Error t value Pr(>|t|)
(Intercept)  2.945e+07  4.837e+06   6.090 2.79e-05 ***
PopulationC  3.271e+01  5.165e+00   6.333 1.85e-05 ***
EmpC        -8.990e+01  8.509e+00 -10.566 4.71e-08 ***
CADUSD       3.212e+07  3.408e+06   9.423 1.94e-07 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

H.8 REGION 8: MONTANA – ALBERTA – SASKATCHEWAN




```
Coefficients:
           Estimate Std. Error t value Pr(>|t|)
RegPop    1.049e+00  5.391e-01   1.946  0.07358 .
UnRatCUS  6.218e+05  1.480e+05   4.200  0.00104 **
Gas_MT   -1.919e+03  8.653e+04  -0.022  0.98264
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
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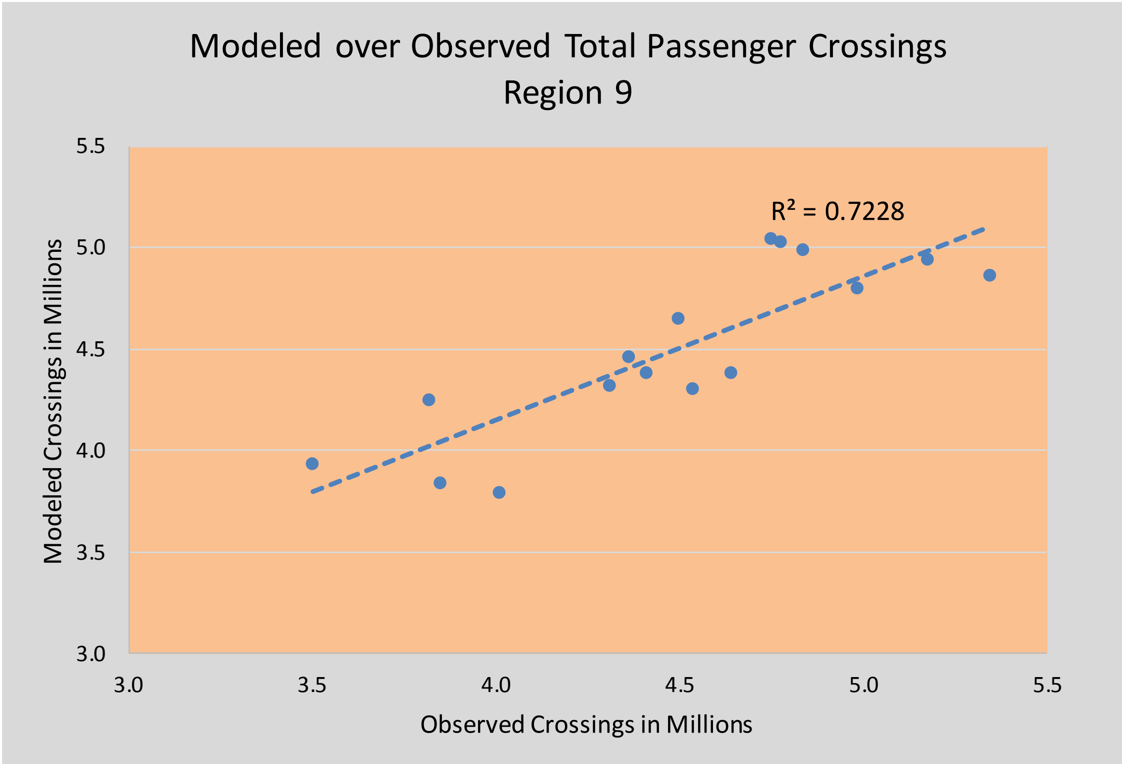
H.9 REGION 9: NORTH DAKOTA – MINNESOTA – MANITOBA – WESTERN ONTARIO




```
Coefficients:
              Estimate Std. Error t value Pr(>|t|)
PopulationC  2.977e+00  6.191e-01   4.809  0.00023 ***
UnRatCUS     1.097e+06  3.438e+05   3.191  0.00608 **
Crude_DpB   -6.048e+03  4.707e+03  -1.285  0.21832
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
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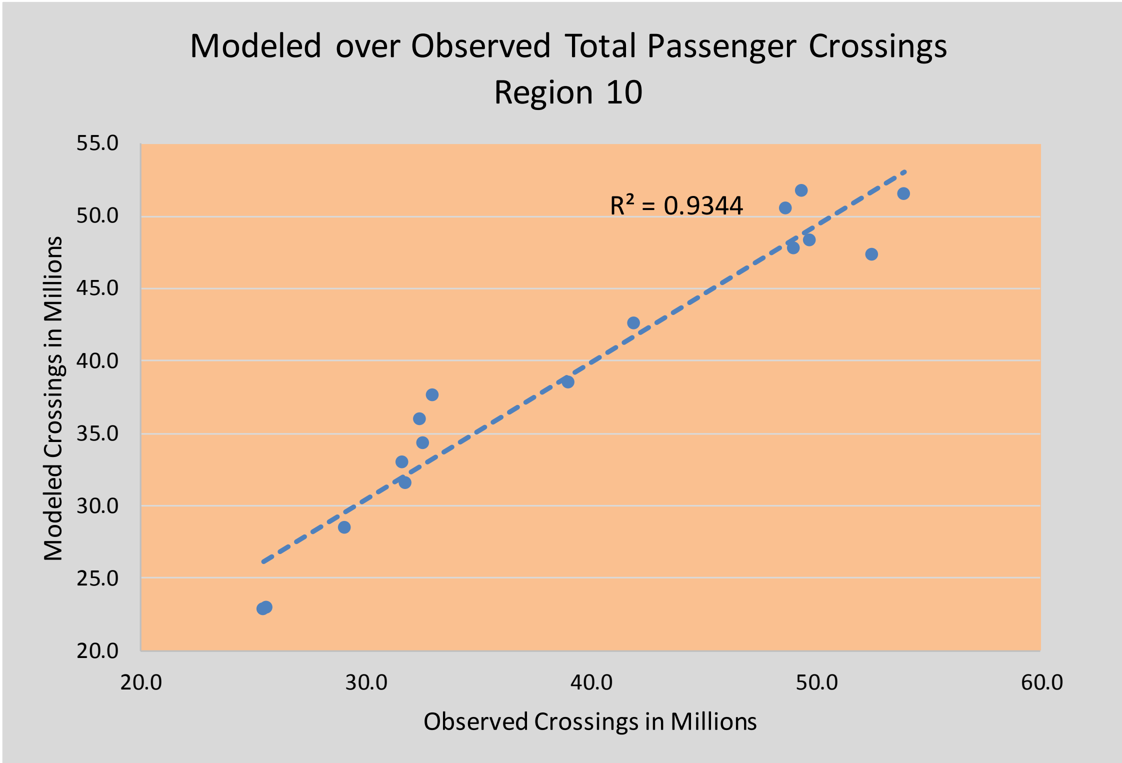
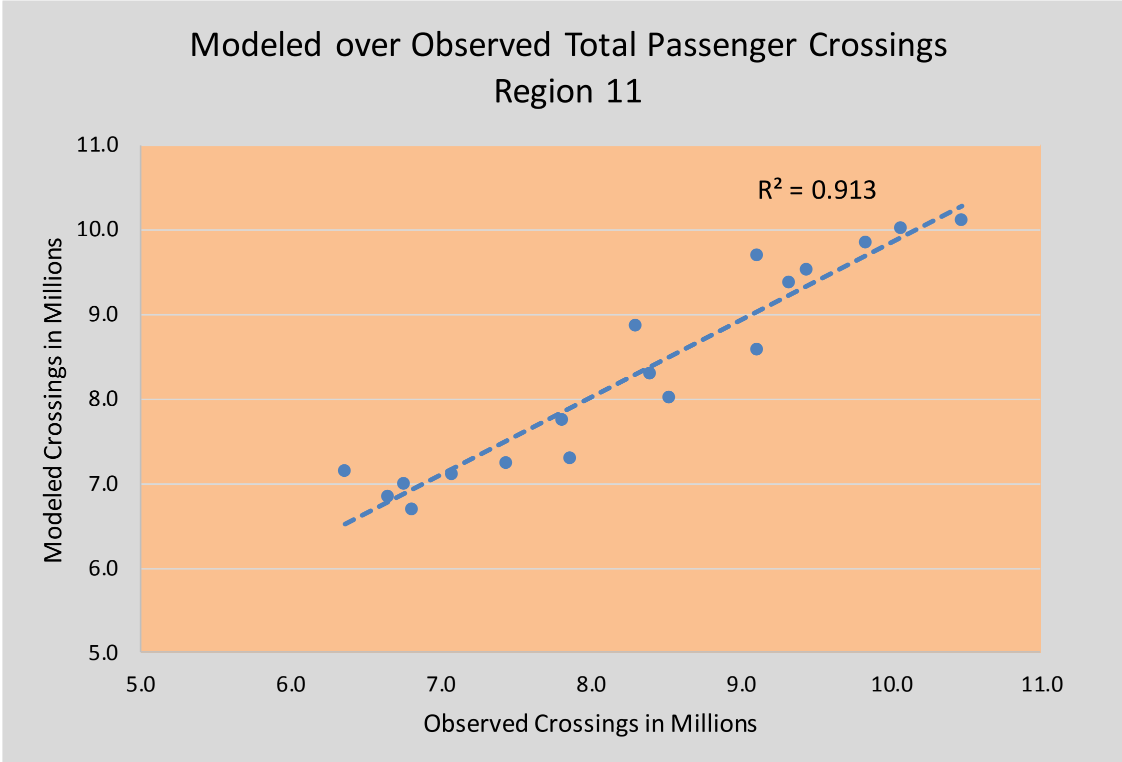
H.10 REGION 10: MICHIGAN AREA



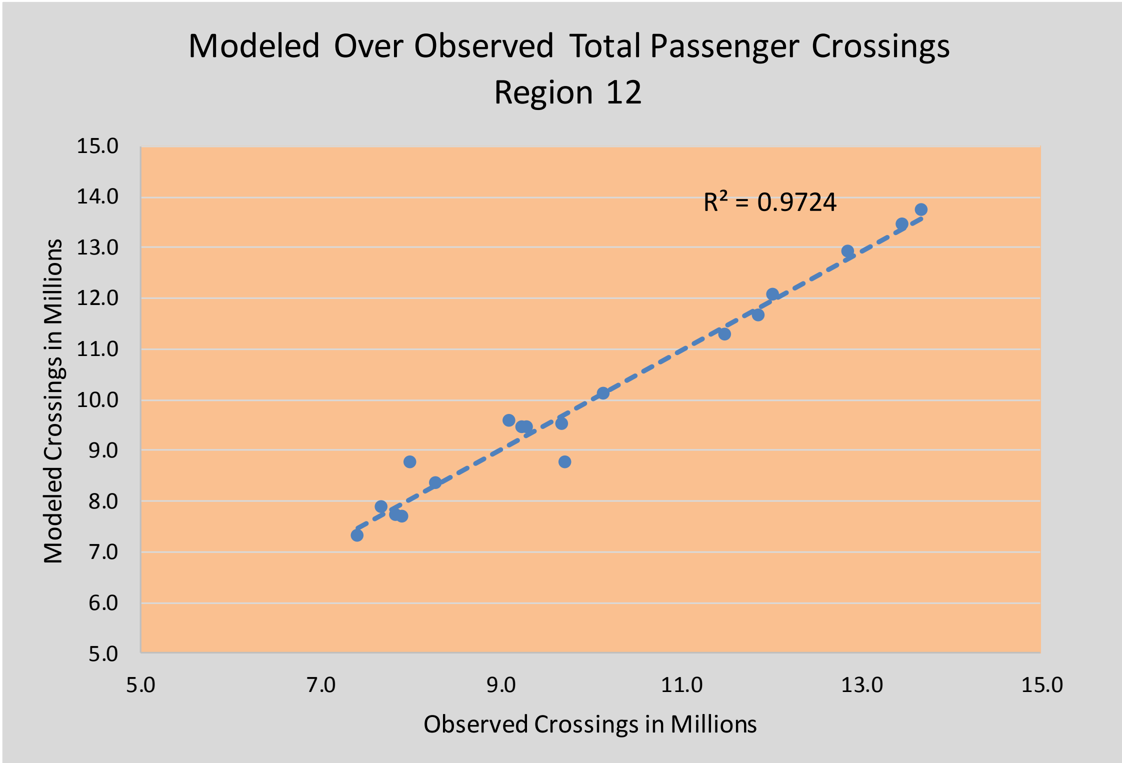

```
Coefficients:
              Estimate Std. Error t value Pr(>|t|)
(Intercept) -57680236   16402715  -3.517  0.00312 **
Emp_Mfg_US      71270       7802   9.135 1.62e-07 ***
CADUSD       36898517   11910612   3.098  0.00735 **
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

H.11 REGION 11: NEW YORK AREA



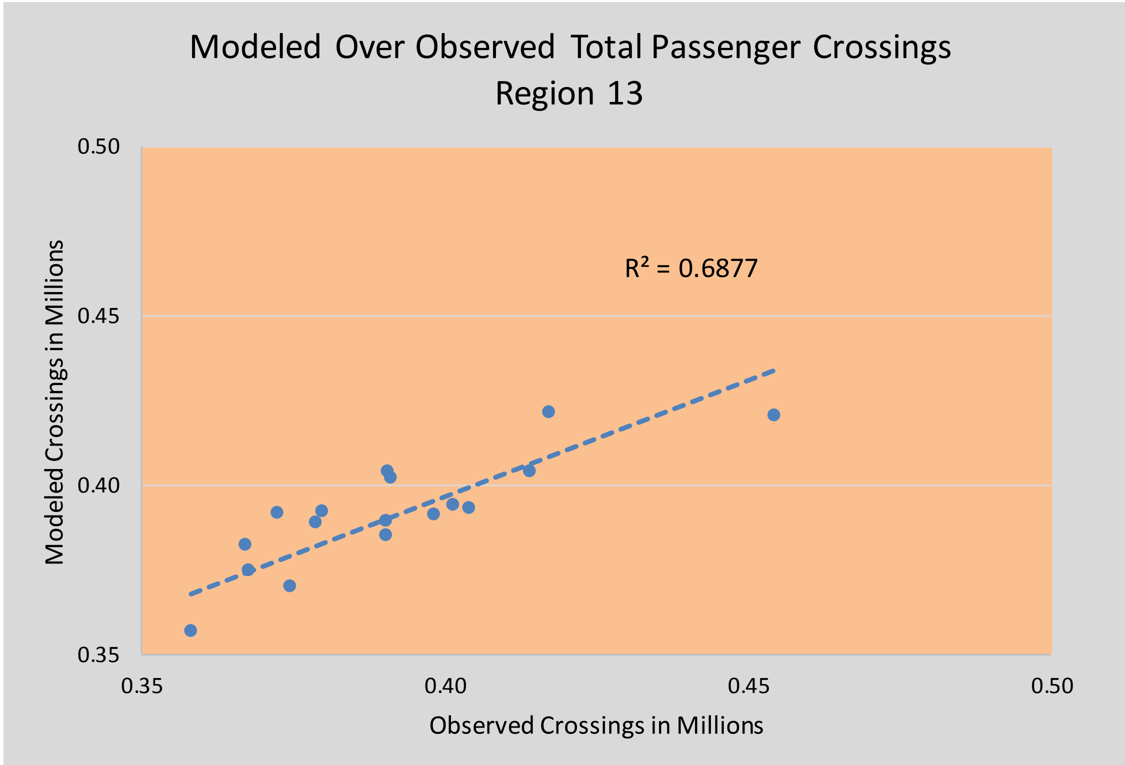

```
Coefficients:
               Estimate Std. Error t value Pr(>|t|)
(Intercept) -1.904e+07  1.769e+07  -1.076  0.29996
PopulationC  3.539e+00  1.937e+00   1.827  0.08908 .
EmpC        -1.202e+01  3.311e+00  -3.630  0.00273 **
EmpKUS       3.046e+01  1.232e+01   2.472  0.02689 *
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

H.12 REGION 12: NEW ENGLAND AREA




```
Coefficients:
         Estimate Std. Error t value Pr(>|t|)
RegPop  1.519e+01  2.118e+00   7.174 4.75e-06 ***
EmpC   -1.190e+02  1.027e+01 -11.592 1.46e-08 ***
EmpKUS  9.021e+01  1.695e+01   5.323 0.000108 ***
CADUSD  9.369e+06  2.452e+06   3.820 0.001874 **
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

H.13 REGION 13: ALASKA – BRITISH COLUMBIA – YUKON TERRITORY




```
Coefficients:
              Estimate Std. Error t value Pr(>|t|)
(Intercept) -7.251e+05  2.432e+05  -2.982 0.009899 **
RegPop       2.460e-01  5.271e-02   4.666 0.000364 ***
UnRatCUS     1.221e+05  3.210e+04   3.806 0.001929 **
Crude_DpB   -1.326e+03  3.264e+02  -4.064 0.001161 **
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```