CHICAGO-FORT WAYNE-LIMA

PASSENGER RAIL CORRIDOR STUDY

PRELIMINARY FORECASTS

APRIL 13, 2017

PREPARED BY:

TEMS

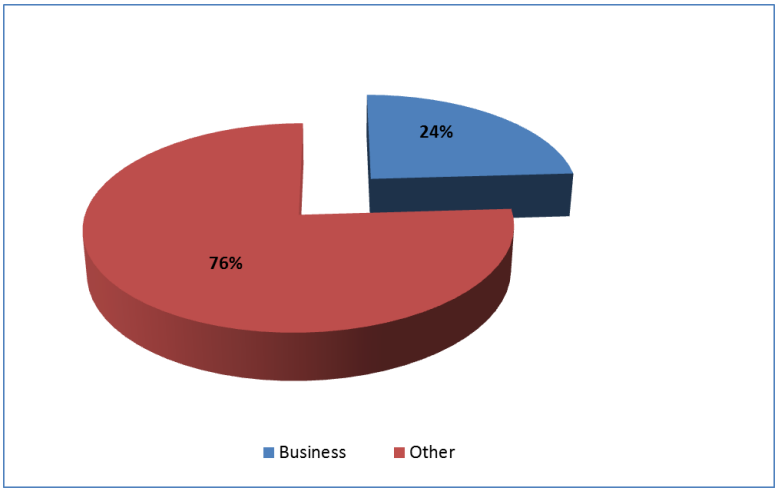
TRANSPORTATION ECONOMICS & MANAGEMENT SYSTEMS, INC.

1 OVERVIEW OF EXISTING TRAVEL MARKET

The Chicago-Ft. Wayne-Lima corridor is an important corridor in the Midwest region. It covers the states of Illinois, Indiana, and Ohio, with a population of 11.85 million in 2015. The Chicago-Ft. Wayne-Lima corridor is distinguished for its high population density and high employment. The region hosts a large number of finance and business services, manufacturing facilities, universities, military bases, and research and high-tech industry. The corridor area currently has nearly seven million jobs and per capita income was $47,194 in 2015 dollars. Projections show that the Chicago-Ft. Wayne-Lima corridor's demographic and economic growth will continue over the next several decades, the population is projected to be 14.5 million in 2040, employment will be nine million in 2040, and per capita income is projected to be $69,966 in 2040 in 2015 dollars.

The Chicago-Ft. Wayne-Lima corridor has a high level of business and commuter travel among its urban areas together with significant social and tourists travel. The total annual intercity trips in the corridor were estimated to be 54 million in 2015. As shown in Exhibit 1, 24 percent of the intercity trips were business trips and 76 percent trips were non-business commuter, social, and tourist trips in 2015.

Exhibit 1: 2015 Corridor Intercity Trips by Purpose



2 BASIC STRUCTURE OF THE COMPASS™ TRAVEL MARKET FORECAST MODEL

The COMPASS™ Multimodal Demand Forecasting Model is a flexible demand forecasting tool used to compare and evaluate alternative passenger rail network and service scenarios. It is particularly useful in assessing the introduction or expansion of public transportation modes such as air, bus or high-speed rail into markets. Exhibit 2 shows the structure and working process of the COMPASS™ Model. As shown, the inputs to the COMPASS™ Model are base and proposed transportation networks, base and projected socioeconomic data, value of time and value of frequency from Stated Preference surveys, and base year travel data obtained from government agencies and transportation service operators.

The COMPASS™ Model structure incorporates two principal models: a Total Demand Model and a Hierarchical Modal Split Model. These two models are calibrated separately. In each case, the models are calibrated for origin-destination trip making in the study area. The Total Demand Model provides a mechanism for replicating and forecasting the total travel market. The total number of trips between any two zones for all modes of travel is a function of (1) the socioeconomic characteristics of the two zones and (2) the travel opportunities provided by the overall transportation system that exists (or will exist) between the two zones. Typical socioeconomic variables include population, employment and income. The quality of the transportation system is measured in terms of total travel time and travel cost by all modes.

The role of the COMPASS™ Modal Split Model is to estimate relative modal shares of travel given the estimation of the total market by the Total Demand Model. The relative modal shares are derived by comparing the relative levels of service offered by each of the travel modes. Three levels of binary choice were used in this study (see Exhibit 3). The first level separates rail services from bus services. The second level of the hierarchy separates air travel, the fastest and most expensive mode of travel, from surface modes of rail and bus services. The third level separates auto travel with its perceived spontaneous frequency, low access/egress times, and highly personalized characteristics, from public modes (i.e., air, rail and bus). The model forecasts changes in riders, revenue and market share based on changes travel time, frequency and cost for each mode.

Exhibit 2: Structure of the COMPASS™ Model

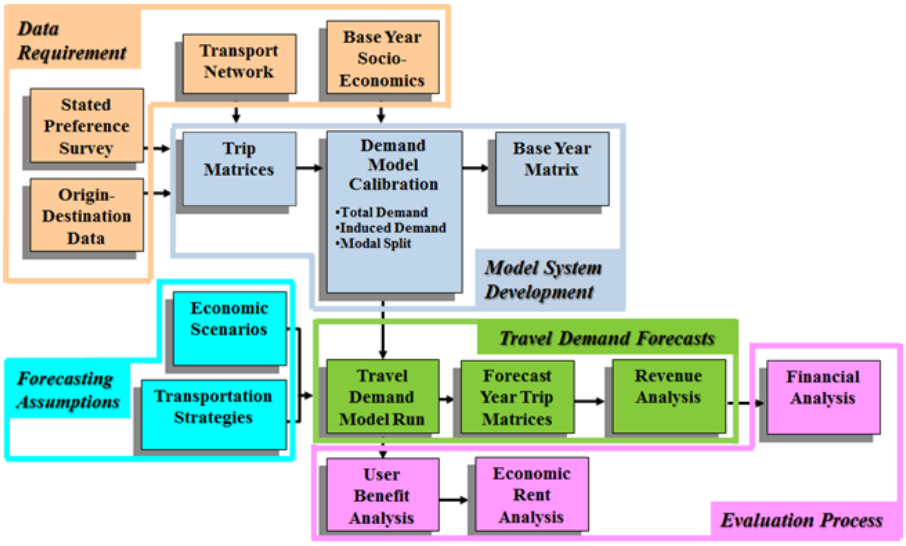
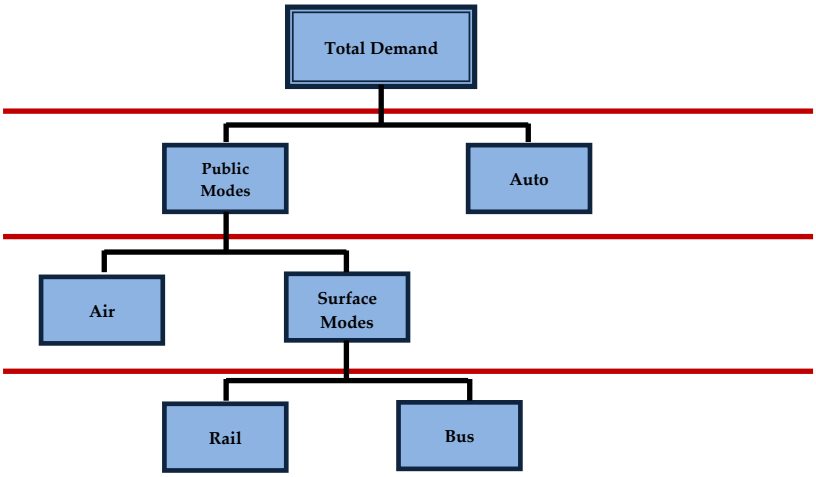


Exhibit 3: Hierarchical Structure of the Modal Split Model



A key element in evaluating passenger rail service is the comprehensive assessment of the travel market in the corridor under study, and how well the passenger rail service might perform in that market. For the purpose of this study, this assessment was accomplished using the following process:

- Building the zone system that enables more detailed analysis of the travel market and developing base year and future socioeconomic data for each zone.
- Compiling information on the travel market in the corridor for auto, air, bus, and the proposed passenger rail travel.
- Identifying and quantifying factors that influence travel choices, including future gas

price, future vehicle fuel efficiency improvement, and highway congestion.

- Developing and calibrating total travel demand and modal split models for travel demand forecasting.
- Forecasting travel, including total demand and modal shares.

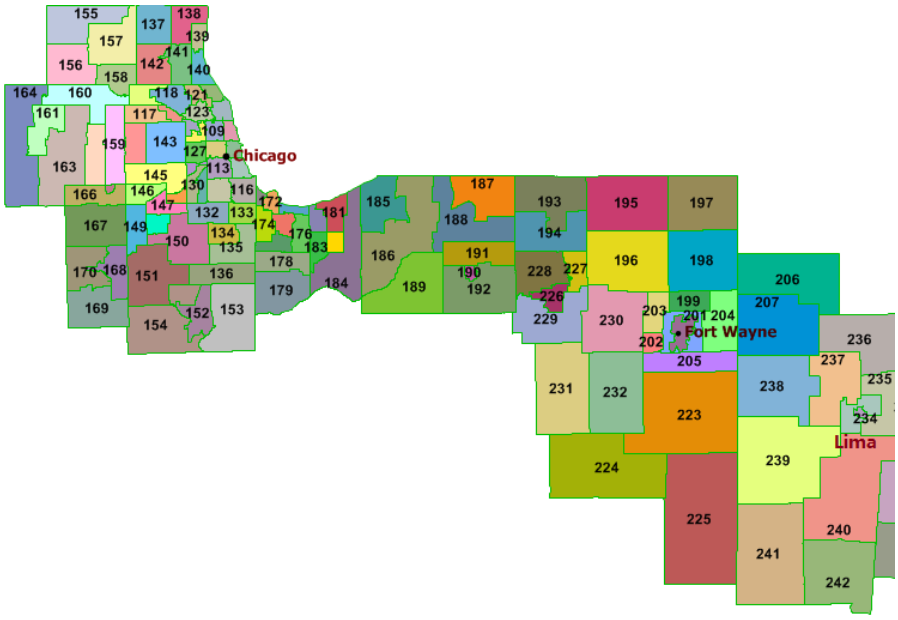
The following sections document the modeling process and the forecasting results.

3 ZONE DEFINITION

The zone system provides a representation of the market areas among which travel occurs from origins to destinations. For intercity passenger rail planning, most rural zones can be represented by larger areas. However, where it is important to identify more refined trip origins and destinations in urban areas, finer zones are used. The travel demand model forecasts the total number of trip origins and destinations by mode and by zone pair.

A 120-zone system was developed for the Chicago-Ft. Wayne-Lima corridor region based on the 2010 census tracts and traffic analysis zones of local metropolitan planning agencies. The study area includes the states of Indiana, Ohio, and Illinois. In the zone system, there are 45 zones in Indiana, 13 zones in Ohio, and 62 zones in Illinois. Exhibit 4 shows the 142-zone system for the corridor study area.

Exhibit 4: Study Area Zone System



4 SOCIOECONOMIC BASELINE AND PROJECTIONS

The travel demand forecasting model requires base year estimates and future growth forecasts of three socioeconomic variables of population, employment and per capita income for each of the zones in the study area. A socioeconomic database was established for the base year (2015) and for each of the future years (2020-2055). The data was developed at five-year intervals using the most recent census data, as well as the latest economic forecasts.

Base-year estimates were developed using U.S. Census data and recent estimates from the Bureau of Economic Analysis (U.S. Department of Commerce), socioeconomic data of local planning agencies, and Woods & Poole Economics, a firm that specializes in long-term demographic and economic projections that have been widely used by government agencies, consulting firms and retailers. Forecasts by zone were made using the Bureau of Economic Analysis historical data, local planning agency forecasts, and Woods & Poole Economics socioeconomic forecasts.

Exhibit 5 shows the base year and projected socioeconomic data in the study area. According to the data developed from these sources, the population of the study area will increase from 11.85 million in 2015 to 16.56 million in 2055, the total employment of the study area will increase from 6.88 million to 10.77 million in 2055, and per capita income will increase from $47,194 in 2015 to $87,523 in 2055 in 2015 dollars.

Exhibit 5: Study Area Base and Projected Socioeconomic Data

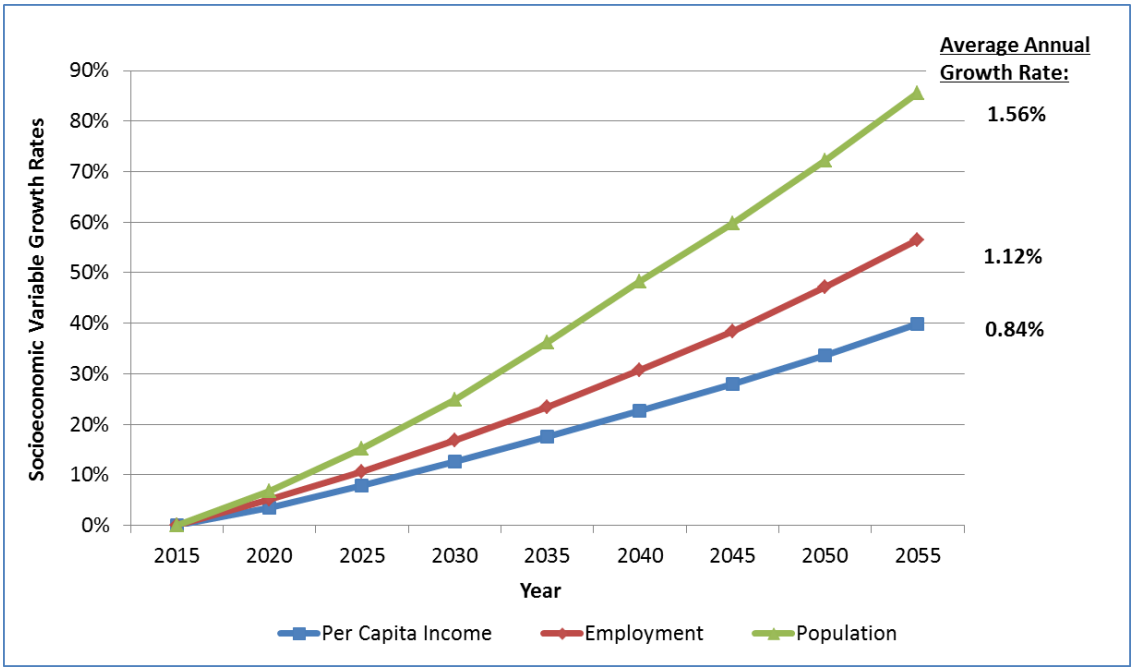
Year	2015	2020	2025	2030	2035	2040	2045	2050	2055
Population	11,849,797	12,266,297	12,785,748	13,337,449	13,921,425	14,539,898	15,156,913	15,837,941	16,564,856
Employment	6,887,638	7,239,944	7,623,627	8,042,711	8,502,079	9,007,576	9,538,449	10,137,063	10,773,245
Per Capita Income (2015$)	47,194	50,434	54,363	58,971	64,237	69,966	75,418	81,245	87,523

Exhibit 6 shows the socioeconomic growth projections for the study area. The exhibit shows that there is higher growth of employment and income than population. However, travel increases are historically strongly correlated to increases in employment and income, in addition to changes in population. Therefore, travel in the corridor is likely to continue to increase faster than the population growth rates, as changes in employment and income outpace population growth, and stimulate more demand for traveling.

The exhibits in this section show the aggregate socioeconomic projection for the whole study area. It

should be noted that in applying socioeconomic projections to the model, separate projections were made for each of the individual 120 zones using the data from the listed sources. Therefore, the socioeconomic projections for different zones are likely to be different and thus may lead to different future travel sub-market projections.

Exhibit 6: Study Area Socioeconomic Data Growth Rates



5 EXISTING TRAVEL MODES

In transportation analysis, travel desirability is measured in terms of cost and travel time. These variables are incorporated into the basic transportation network elements. Correct representation of the existing and proposed travel services is vital for accurate travel forecasting. Basic network elements are called nodes and links. Each travel mode consists of a database comprised of zones and stations that are represented by nodes, and existing connections or links between them in the study area. Each node and link is assigned a set of attributes. The network data assembled for the study included the following attributes for all the zone pairs.

For public travel modes (air, rail, bus):

- Access/egress times and costs (e.g., travel time to a station, time/cost of parking, time walking from a station, etc.)
- Waiting at terminal and delay times
- In-vehicle travel times

- Number of interchanges and connection times
- Fares
- Frequency of service

For private mode (auto):

- Travel time, including rest time
- Travel cost (vehicle operating cost)
- Tolls
- Parking Cost
- Vehicle occupancy

The transportation service data of different modes available in the study corridor were obtained from a variety of sources and coded into the COMPASS™ networks as inputs to the demand model.

The highway network was developed to reflect the major highway segments within the study area. The sources for building the highway network in the study area are as follows:

- State and Local Departments of Transportation highway databases
- The Bureau of Transportation Statistics HPMS (Highway Performance Monitoring System) database

The main roads included in the highway network are shown in Exhibit 7.

Exhibit 7: Major Roads in the COMPASS™ Highway Network

Road Name	Road Description
Interstate 94	Chicago-Gary
Interstate 90	Gary-South Bend
Interstate 65	Gary-Indianapolis
Interstate 70	Indianapolis -Columbus
Route 130	Gary-Valparaiso
Route 30	Valparaiso-Lima

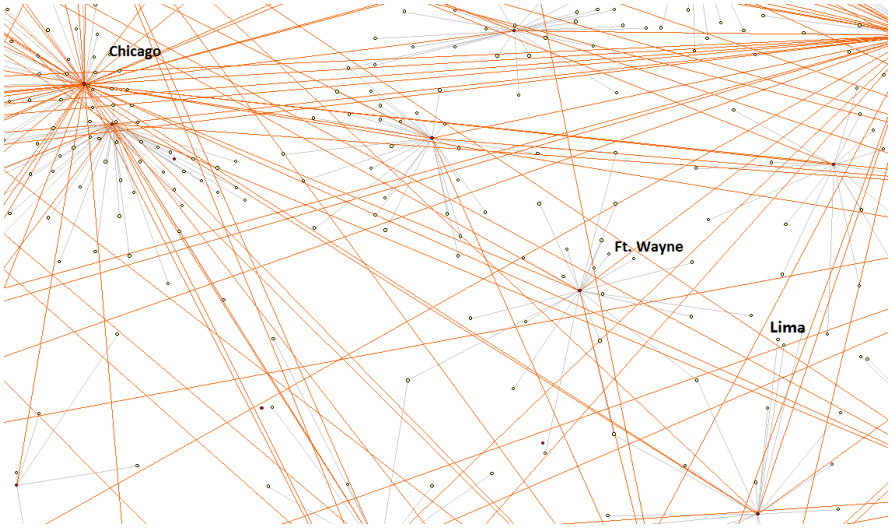
The highway network of the corridor area coded in COMPASS™ is shown in Exhibit 8.

Exhibit 8: COMPASS™ Highway Network for the Corridor Area



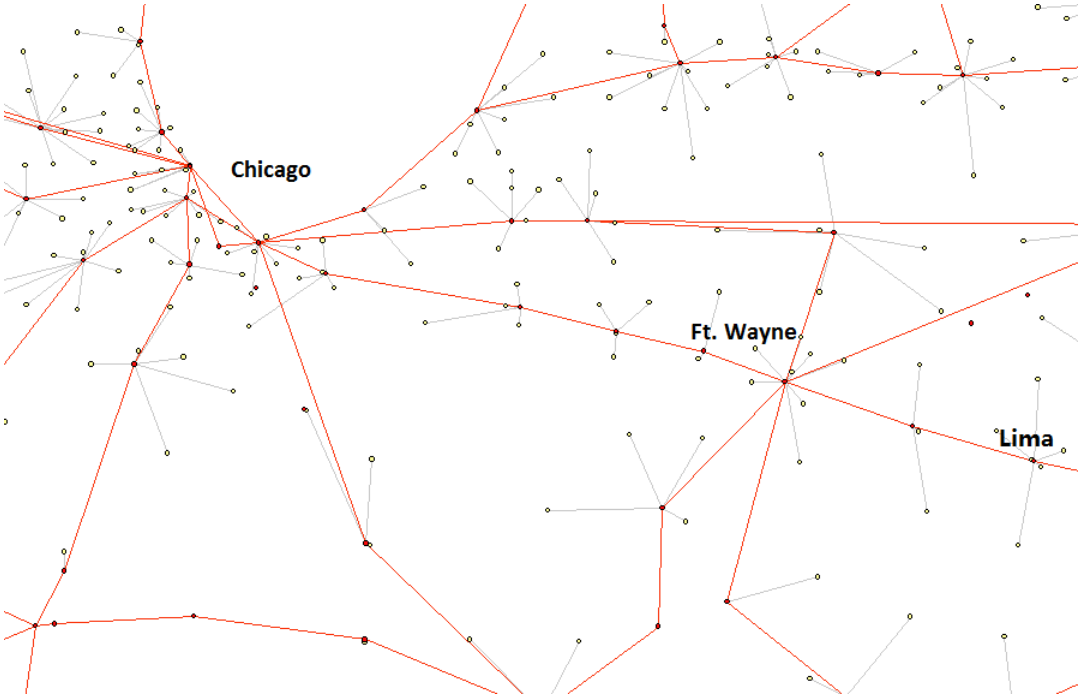
American Airlines, Delta, United Airlines, US Airways, and Southwest Airlines provide air service in the corridor area. Air network attributes contain a range of variables that include time and distance between airports, airfares, and connection times. Travel times, frequencies and fares were derived from official airport websites, websites of the airlines serving airports in the study area, and the BTS 10% sample of airline tickets. Exhibit 9 shows the air network of the corridor area coded in COMPASS™

Exhibit 9: COMPASS™ Air Network for the Corridor Area



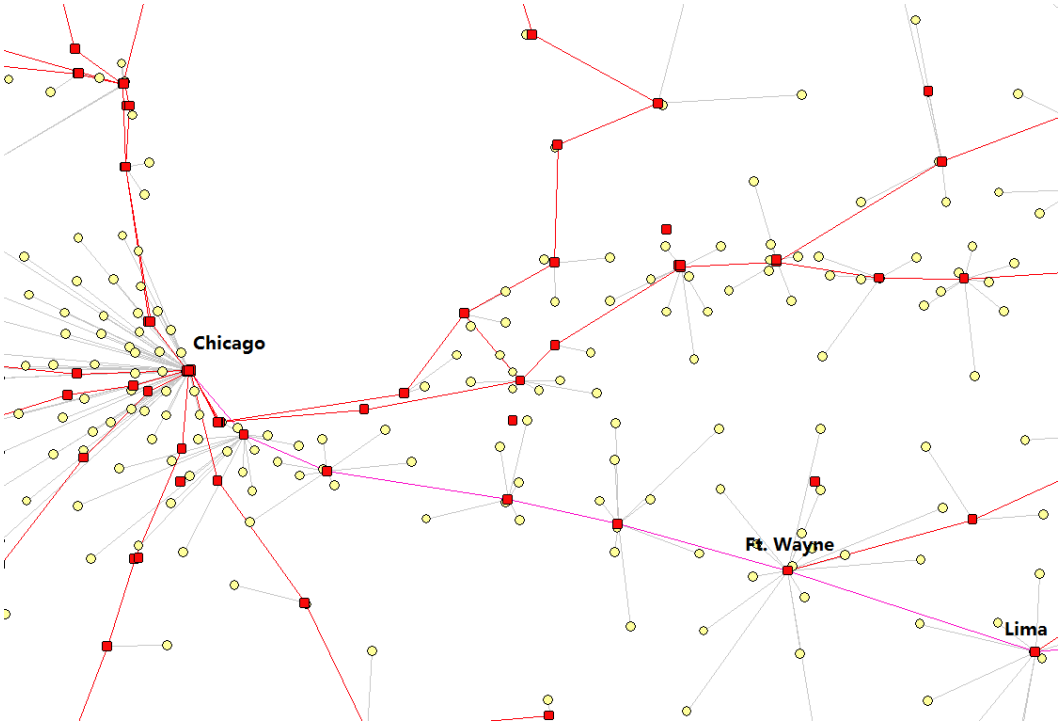
Bus travel data of travel time, fares, and frequencies, were obtained from official schedules of the Greyhound, Megabus, and Lakefront operators. Exhibit 10 shows the bus network of the corridor area coded in COMPASS™

Exhibit 10: COMPASS™ Bus Network for the Corridor Area



There is no existing passenger rail service in the Chicago-Ft. Wayne-Lima corridor. The proposed passenger rail service in the corridor will have stations in Chicago Union Station, Gary Airport, Valparaiso, Plymouth, Warsaw, Fort Wayne, and Lima. There are four service scenarios: 79 MPH 2 DRTs, 79 MPH 4 DRTs, 79 MPH 6 DRTs, 110 MPH 4 DRTs, and 110 MPH 6 DRTs. The 79 MPH service will begin in 2025 and the 110 MPH service will be in operation in 2035. Exhibit 11 shows the proposed passenger rail network in the corridor.

Exhibit 11: COMPASS™ Passenger Rail Network for the Corridor Area



6 ORIGIN-DESTINATION TRIP DATABASE

The multi-modal intercity travel analyses model requires the collection of base year 2015 origin-destination (O-D) trip data describing annual personal trips between zone pairs. For each O-D zone pair, the annual personal trips are identified by mode (auto, air, and bus) and by trip purpose (Business and Non-Business). Because the goal of the study is to evaluate intercity travel, the O-D data collected for the model reflects travel between zones (i.e., between counties, neighboring states and major urban areas) rather than within zones.

TEMS extracted, aggregated and validated data from a number of sources in order to estimate base travel between origin-destination pairs in the study area. The data sources for the origin-destination trips in the study are:

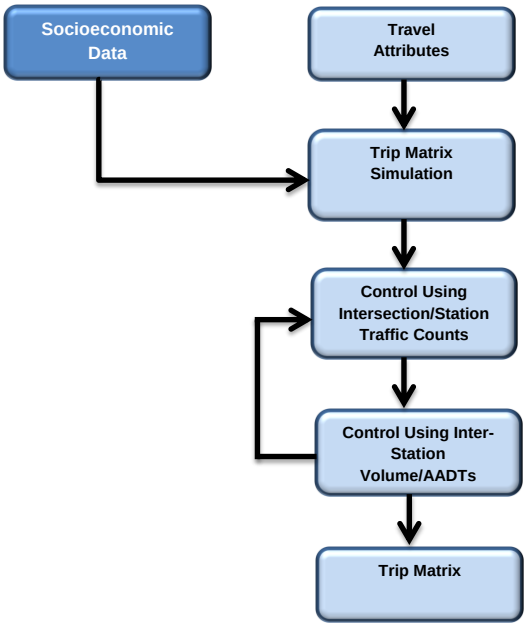
- 2004 MWRRI Study Database
- Amtrak station-to-station trip and station volume data
- Annual average daily traffic (AADT) from state DOTs
- BTS ten percent Ticket Samples

The travel demand forecast model requires the base trip information for all modes between each

zone pair. In some cases this can be achieved directly from the data sources, while in other cases the data providers only have origin-destination trip information at an aggregated level (e.g., AADT data, station-to-station trip and station volume data). Where that is the case, a data enhancement process of trip simulation and access/egress simulation needed to be conducted to estimate the zone-to-zone trip volume. The data enhancement process is shown in Exhibit 12.

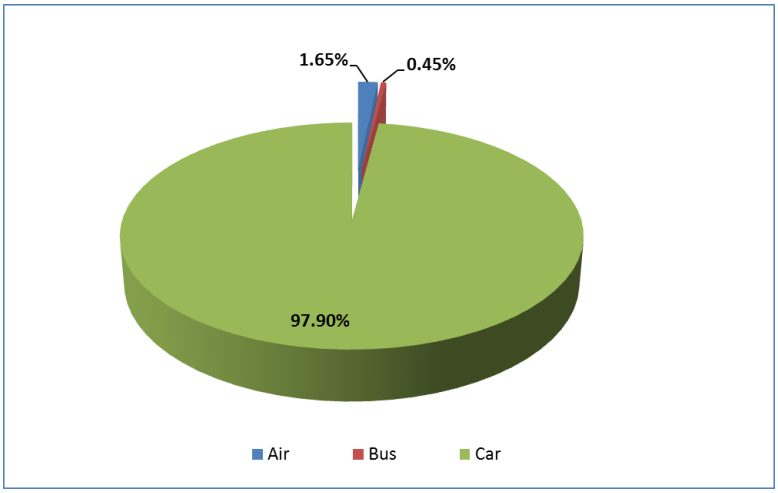
For the auto mode, the quality of the origin-destination trip data was assured by comparing it to AADTs and traffic counts on major highways and adjustments have been made when necessary. For public travel modes, the origin-destination trip data was validated by examining station volumes and segment loadings.

Exhibit 12: Zone-to-Zone Origin-Destination Trip Matrix Generation and Validation



The 2015 intercity and interurban travel market of the Chicago-Ft. Wayne-Lima corridor was estimated to be 54 million. Exhibit 13 shows the base 2015 travel market share of air, bus, and auto modes. It can be seen that auto mode dominates the travel market with nearly 98 percent of market share. Public modes have less than three percent of travel market share.

Exhibit 13 2015 Base Travel Market Share by Mode



7 FUTURE TRAVEL MARKET STRATEGIES

7.1 FUEL PRICE FORECASTS

An important factor in the future attractiveness of passenger rail is fuel price. Exhibit 3-14 shows the Energy Information Agency (EIA)[1] projection of crude oil prices for three oil price cases, namely high world oil price case that is aggressive oil price forecast, reference world oil price case that is moderate and is also known as the central case forecast, and the conservative low world oil price case. In this study, the reference case oil price projection was used to estimate transportation cost in future travel market. EIA projects oil price to 2040, the oil price projections after 2040 were estimated based on historical prices and EIA projections. The EIA reference case forecast suggests that crude oil prices is expected to be $92 per barrel (2015$) in 2025 and will remain at that high level and will increase to $136 per barrel (2015$) in 2040.

EIA has also developed future retail gasoline price forecast, which is shown in Exhibit 3-15. The implication of this is a reference case gasoline price of $3 per gallon (2015$) in 2025, with a high case price of $4.9 per gallon and a low case price of $2 per gallon. The estimated $5 per gallon once the economy starts to grow again seems realistic, while the $2 per gallon has been a 'floor' price throughout the last eight years since the recession.

[1] EIA periodically updates historical and projected oil prices at www.eia.gov/forecasts/aeo/tables_ref.cfm

Exhibit 14: Crude Oil Price Forecast by EIA

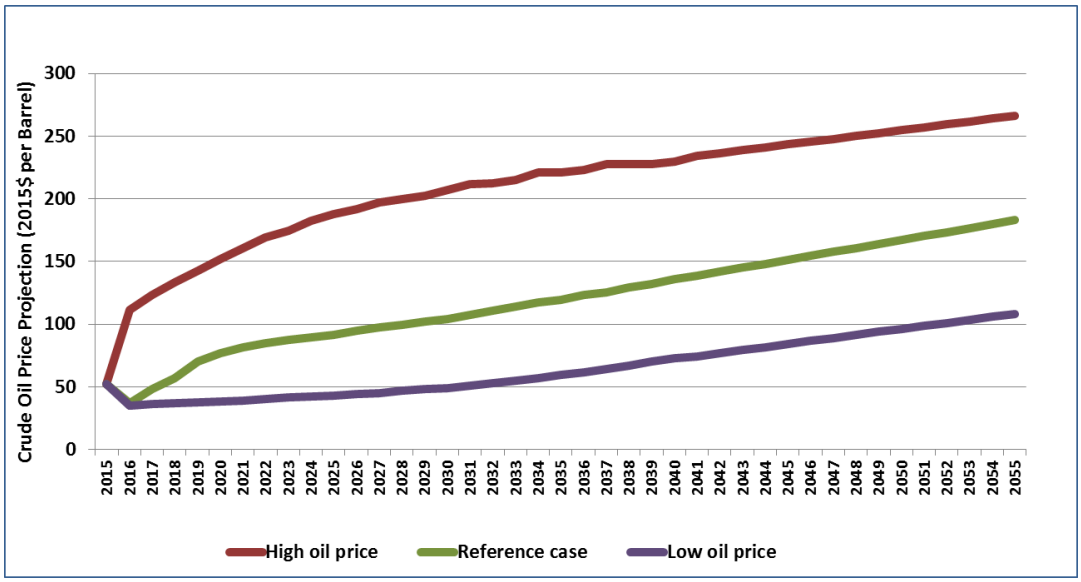
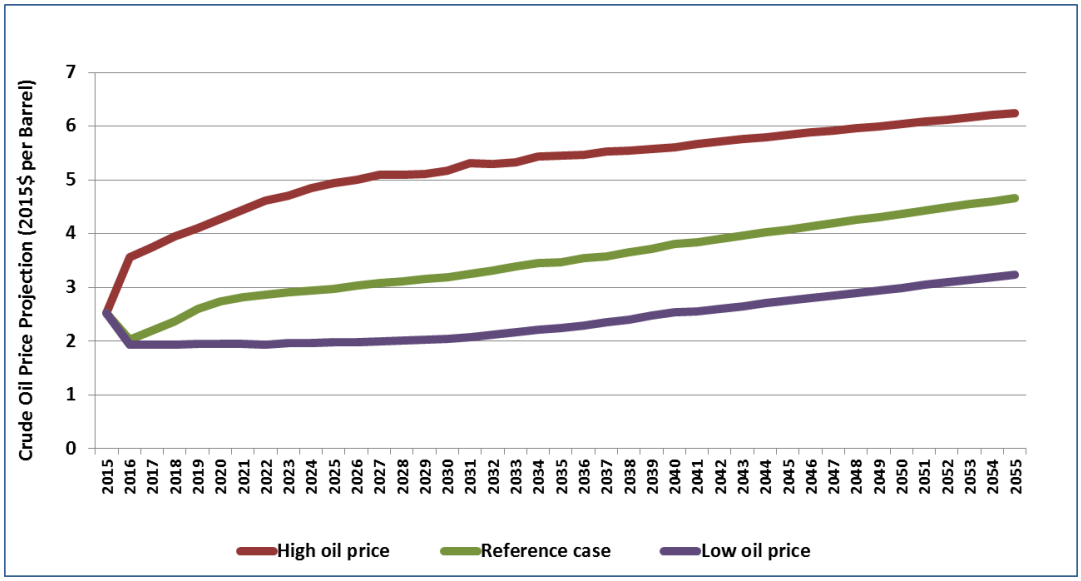


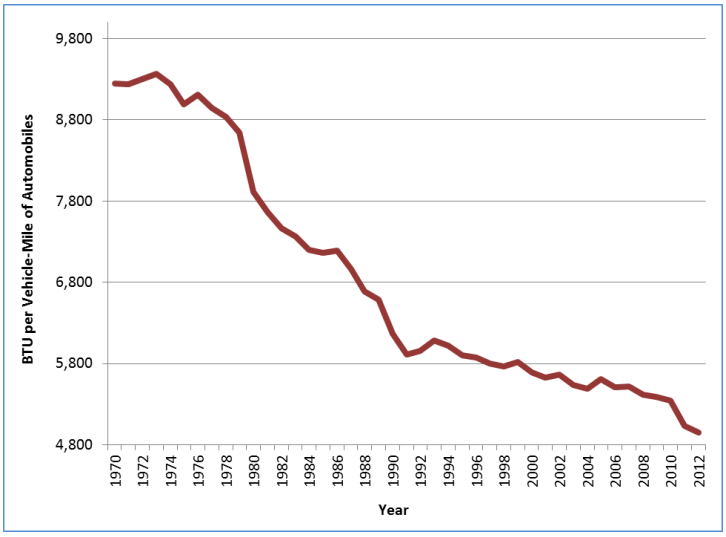
Exhibit 15: U.S. Retail Gasoline Prices Forecast by EIA



7.2 VEHICLE FUEL EFFICIENCY FORECASTS

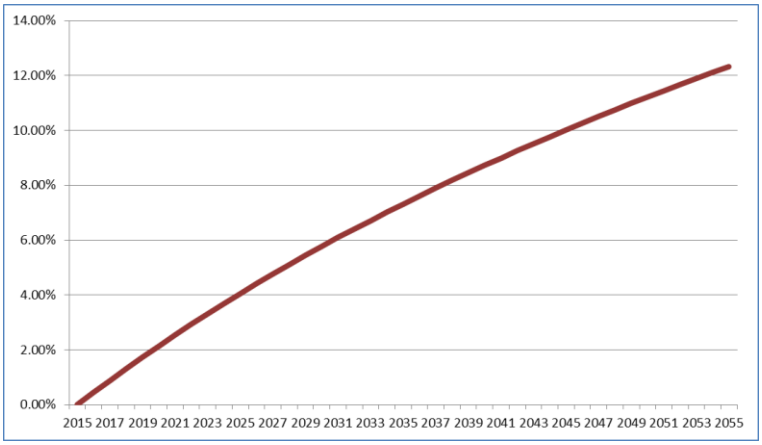
Future improvement in automobile technology is likely to reduce the impact of high gas prices on automobile fuel cost with better fuel efficiency. The EIA Energy Intensities of Highway Passenger Modes Data Table has the historical Btu (British thermal unit) per vehicle-mile data for automobiles since 1970 as show in Exhibit 16.

Exhibit 16: EIA Historical Highway Automobile Energy Intensities Data



From Exhibit 16 it can be seen that automobile fuel efficiency has been improving gradually during the past few decades but the improvement has slowed down in recent years. Future automobile fuel efficiency improvement that was projected and shown in Exhibit 17 was based on the historical automobile fuel efficiency data. It shows that automobile fuel efficiency is expected to improve by nearly 13 percent by 2055

Exhibit 17: Auto Fuel Efficiency Improvement Projections



7.3 HIGHWAY TRAFFIC CONGESTION

The level of service of auto and bus travel incorporates the highway congestion scenarios to ensure that the automobile traveling impedances are properly reflected. The average highway travel time in the Chicago-Ft. Wayne-Lima corridor was estimated to have an average annual growth rate of 0.4% due to increased travel demand and congestion. This means that the auto travel time from Chicago to Lima will increase by 17 percent in 2055.

To estimate travel time increase within the corridor, historical highway traffic volumes were obtained from the state DOTs and local planning agencies. The average annual travel time growth in the corridor was estimated with the historical highway traffic volume data and the BPR (Bureau of Public Roads) function that can be used to calculate travel time growth with increased traffic volumes.

$$T_a = T_d * [1 + \alpha * \left(\frac{V}{C}\right)^{\beta}]$$

where

T_a is actual travel time,

T_d is highway design travel time,

V is traffic volume,

C is highway design capacity,

α is a calibrated coefficient and is often set to 0.15 for highway segments,

β is a calibrated coefficient and is often set to 4.0 for highway segments.

Future travel times then can be calculated based on historical data for each segment of the highway route with assumptions as shown below:

- α = 0.15
- β = 4.0
- Highway lane capacity = 1600 vehicles/hour
- Number of lanes is based on actual situation of each highway segment

As a result, passenger rail offers an increasing time advantage over auto and bus travel markets that rely upon highway infrastructure and are affected by increasing congestion and travel times. The time advantage will have greater impact on business and commuter travel purposes which have higher values of time and which makes the high speed rail more competitive with these travelers.

7.4 PROPOSED PASSENGER RAIL SERVICE

The running times of the passenger rail service scenarios in the Chicago-Ft. Wayne-Lima corridor are shown in Exhibit 18.

Exhibit 18: Chicago-Ft. Wayne-Lima Corridor Passenger Rail Service Scenarios

	79 MPH	110 MPH
Chicago Union, IL	0:00:00	0:00:00
Gary Airport, IN	0:30:34	0:25:25
Valparaiso, IN	0:52:20	0:43:17
Plymouth, IN	1:29:26	1:10:15
Warsaw, IN	1:55:15	1:28:36
Fort Wayne, IN	2:33:18	1:55:29
Lima, OH	3:27:04	2:34:54

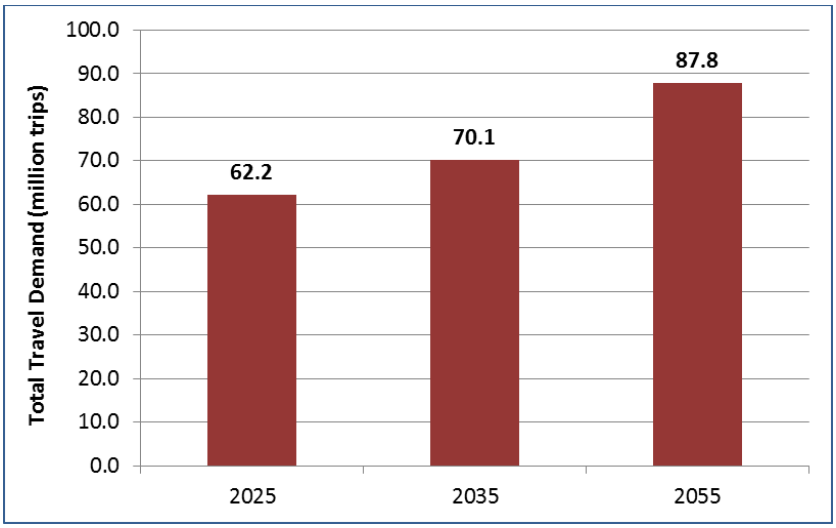
The preliminary passenger rail forecasts include 79 MPH 2 DRTs, 4 DRTS, and 6 DRTS in 2025, 2035, and 2055 and 110 MPH 4 DRTs and 6 DRTs in 2035 and 2055. The average fare used in the forecasts is 28 cents per mile.

8 CORRIDOR TRAVEL MARKET FORECASTS WITHOUT PASSENGER RAIL SERVICE

This section presents the Chicago-Ft. Wayne-Lima corridor travel market forecast without the passenger rail service. In the 2015 base year, the available transportation modes available for the corridor intercity travel market are auto, air, and bus with 54 million trips per year. The auto mode has 97.9 percent market share of the intercity and inter-urban travel market, air mode has 1.65 percent share of the intercity and inter-urban travel market, and bus has 0.45 percent of the market share. By applying the *COMPASS*™ mode choice and total demand models without the passenger rail mode, the travel market with the existing modes can be estimated for future years.

Exhibit 19 shows the Chicago-Ft. Wayne-Lima corridor total travel demand forecasts for 2025, 2035, and 2055 It can be seen that with the existing transportation modes, the corridor travel demand will increase to 62.2 million in 2025, to 70.1 million in 2035, and increases to 87.8 million in 2055. The average annual corridor travel market growth rate is 1.2 percent, which is in line with the socioeconomic growth within the corridor.

Exhibit 19: Chicago-Ft. Wayne-Columbus Corridor Travel Demand Forecast (million trips)



9 CORRIDOR TRAVEL MARKET FORECASTS WITH PASSENGER RAIL SERVICE

Exhibit 20 presents the passenger rail ridership forecasts for the Chicago-Ft. Wayne-Lima corridor for years 2025, 2035, and 2055. The 110 MPH service will start in 2035. The rail mode has 330 thousand trips in 2025 for the 79 MPH 2 DRTS service and will be two million in 2055 if 110 MPH 6 DRTs is in operation.

Exhibit 20: Rail Ridership Forecasts (million)

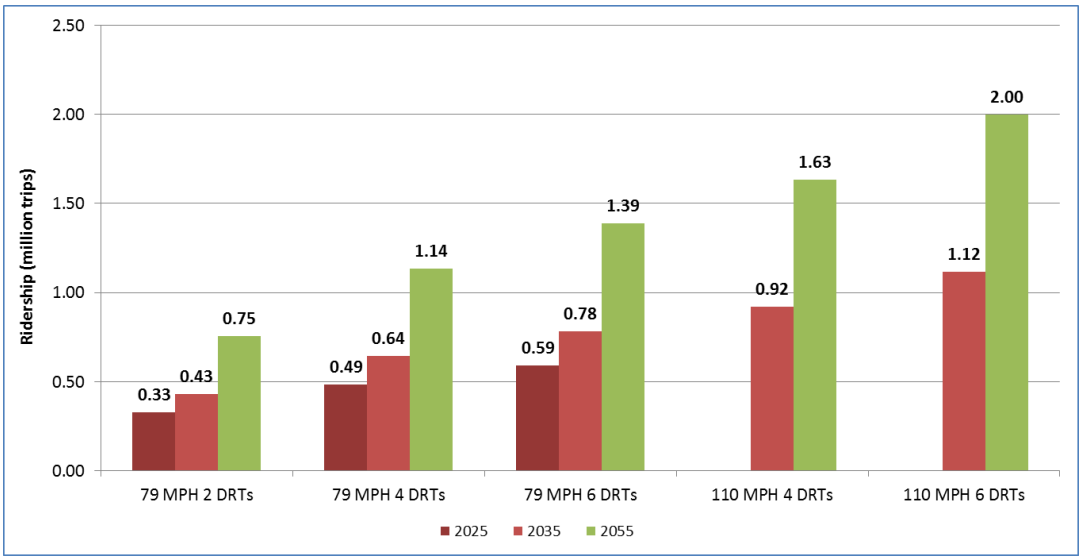
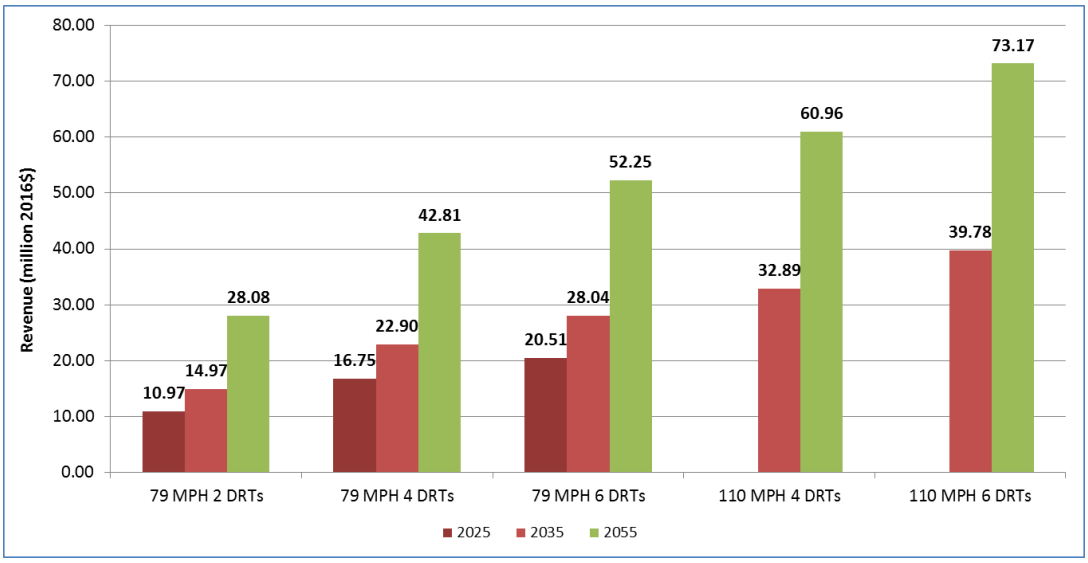


Exhibit 21 shows the annual fare-box revenue for years 2025, 2035, and 2055. The 110 MPH service will start in 2035. The rail mode has 10.97 million dollars of revenue in 2025 for the 79 MPH 2 DRTS service and will be 73.17 million in 2055 for the 110 MPH 6 DRTs service.

Exhibit 21: Rail Fare-Box Revenue Forecasts (million $2016)



The corridor transportation mode market share forecasts of 2035 are shown in Exhibit 22. The auto mode continues to demonstrate its dominance in the corridor maintaining a market share above 95 percent in 2035. Rail market share will be 0.6 percent for 79 MPH 2 DRTs service and will increase to 1.6 percent for 110 MPH 6 DRTs service. Air market share will be 2.5 percent to 2.6 percent in the corridor, and the market share growth is due to increased congestion and fuel prices. Bus market share will be at 0.4 to 0.6 percent.

Exhibit 22: Chicago-Ft. Wayne-Lima Corridor Travel Market Share Forecast – 2035

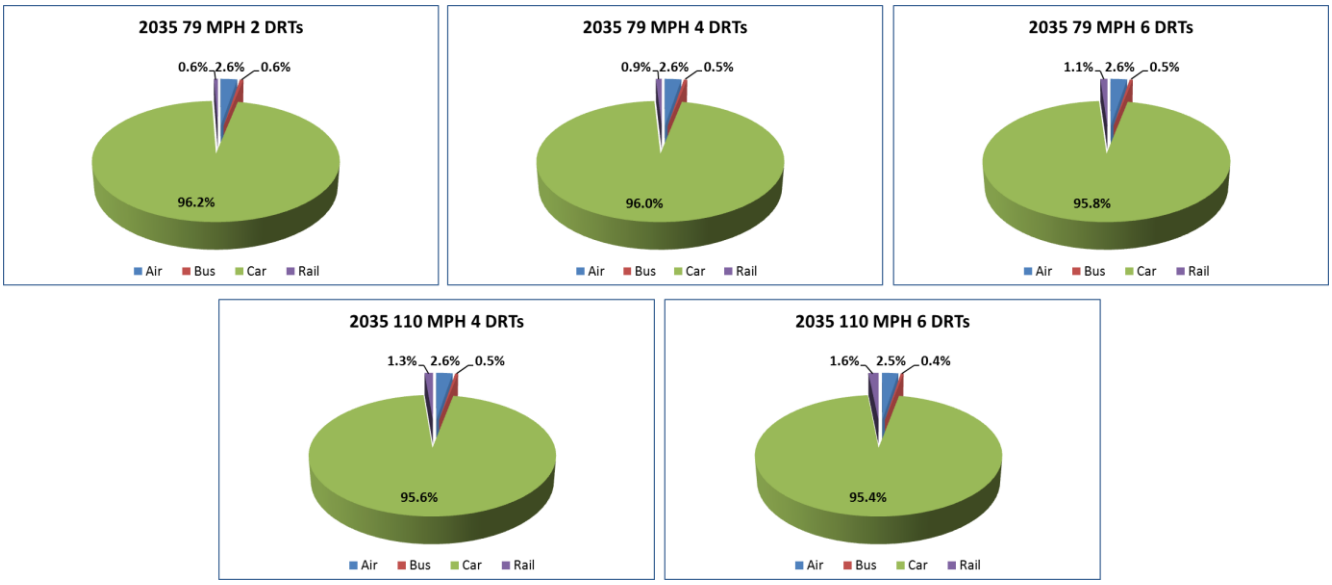


Exhibit 23 illustrates the sources of the rail trips in 2035. The trips diverted from other modes are the most important source of rail trips, which accounts for over 90 percent of overall rail travel market. Induced travel demand in the corridor as result of the new passenger rail service is 1.7 percent for the 79 MPH 2 DRTs service and will increase to 8.4 percent for the 110 MPH 6 DRTs service. As for the diverted trips from other modes, 86 to 97 percent trips are from auto mode, but the auto driving still dominates future travel market, this is because auto driving has a strong base in the current Chicago-Ft. Wayne-Lima corridor.

Exhibit 23: Chicago-Ft. Wayne-Lima Corridor Rail Trip Sources Forecast – 2035

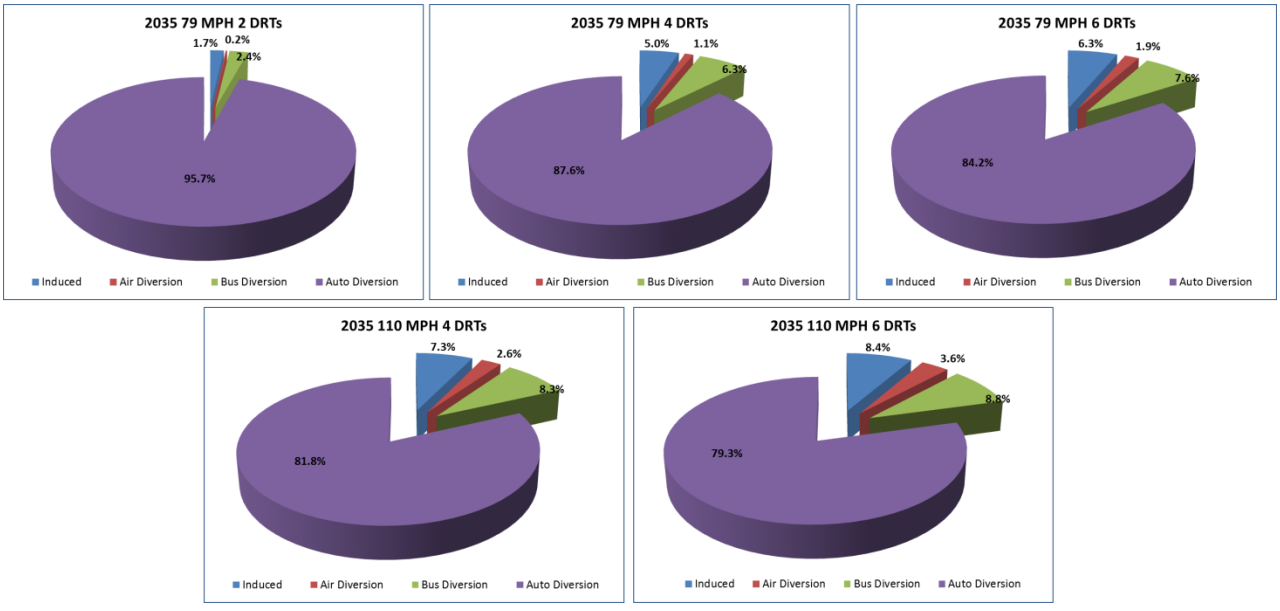


Exhibit 24 shows the station volumes of 79 MPH 2 DRTs, 4 DRTs, and 6 DRTs and 110 MPH 4 DRTs and 6 DRTs in 2035. It can be seen that Chicago has the highest station volume. Gary Airport, Ft. Wayne, and Lima as major stations have higher station volumes than stations in Valparaiso, Plymouth, and Warsaw.

Exhibit 24: Passenger Rail Station Volume Forecast – 2035 (million ons and offs)

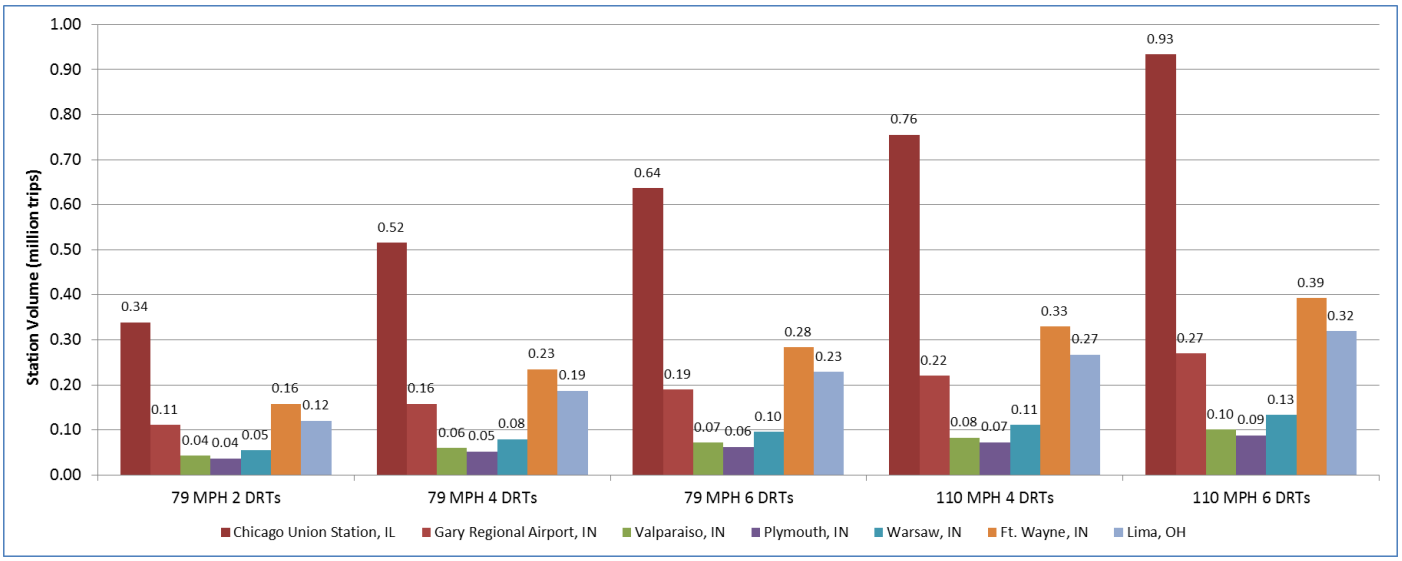


Exhibit 25 shows the segment loadings of 79 MPH 2 DRTs, 4 DRTs, and 6 DRTs and 110 MPH 4 DRTs and 6 DRTs in 2035.

Exhibit 25: 2035 Passenger Rail Segment Loading Forecast –2035 (million trips)

