

APPENDIX C

FREIGHT FLOWS

Flow data show the current state of freight demand, interactions with other geographic areas, commodity types (and by association, their industry sector), and economic values of these shipments. This is of particular value to SEMCOG when assessing the adequacy of freight infrastructure to serve freight movement demands. If monitored over time, the information can show the effects of changes in trip interaction patterns, modes used, and sheer quantity of demand.

ANALYSIS PROCESS

DATA

TRANSEARCH – The core data source for the freight flow analysis is 2009 Transearch data from Global Insight, provided by MDOT. The Transearch data are updated periodically from public sources; such as the Federal Commodity Flow Survey, and Carload/Waybill information. These data are combined with information gleaned from Global Insight’s proprietary industry sources. The Transearch dataset is considered to be the most up-to-date and accurate of all commodity flow/freight datasets. MDOT is a subscriber to the Transearch data, and have indicated that they will continue to obtain future updates. MDOT currently has the 2003, 2006, and 2009 datasets. The Transearch data are massive, covering all commodities and all modes, literally millions of detailed freight movement trip records in origin-destination format. The data used for this project have a base year of 2009, and forecasts for 2010, 2015, 2020, 2025, and 2030.

RAW TRIP RECORDS – The data are highly detailed, with 762 Commodity classified using the STCC4 coding. Each trip origin and destination is coded according to 470 Geographic regions in North America. They are organized at the county level in Michigan, and for each BEA95 (Bureau of Economic Analysis) district in the rest of the USA. For Canada and Mexico, the equivalent of BEA districts are used. These are the states of Mexico, the provinces of Canada. Some selected metro areas of Canada are in separate districts. Total distance is reported for each trip, but is an estimate based on national network distances (extra distance due to hub and spoke movements may not always be correctly represented). The trip records also include the mode used for each shipment, and these are organized into 11 distinct categories (multiple truck & rail modes). Shipment trip records are expressed in units of tonnage, TEU, and value in dollars. For shipments involving an origin or destination outside of North America, the origin or destination is shown in the dataset at the port of entry.

VALIDITY OF USING 2009 BASE YEAR DATA – During the September 2011 Steering Committee meeting, a concern was expressed regarding the validity of Transearch forecasts given that the base year of the data is 2009. The data were collected during the period when the auto bailout was in progress. Because of the national recession, auto demand plummeted, and auto production was greatly reduced. However, after doing some data validation, a close correlation was found between the 2009 dip, and 2010 rebound in auto production and the freight flows shown in the Transearch data for the transportation commodity sector in 2009 and 2010 (see Figures C-1 and C-2). Because Transearch is also showing the 2010 rebound, it was determined that the forecasts can legitimately be used for this study.

Figure C-1
North American Motor Vehicle Production Statistics 1999-2010

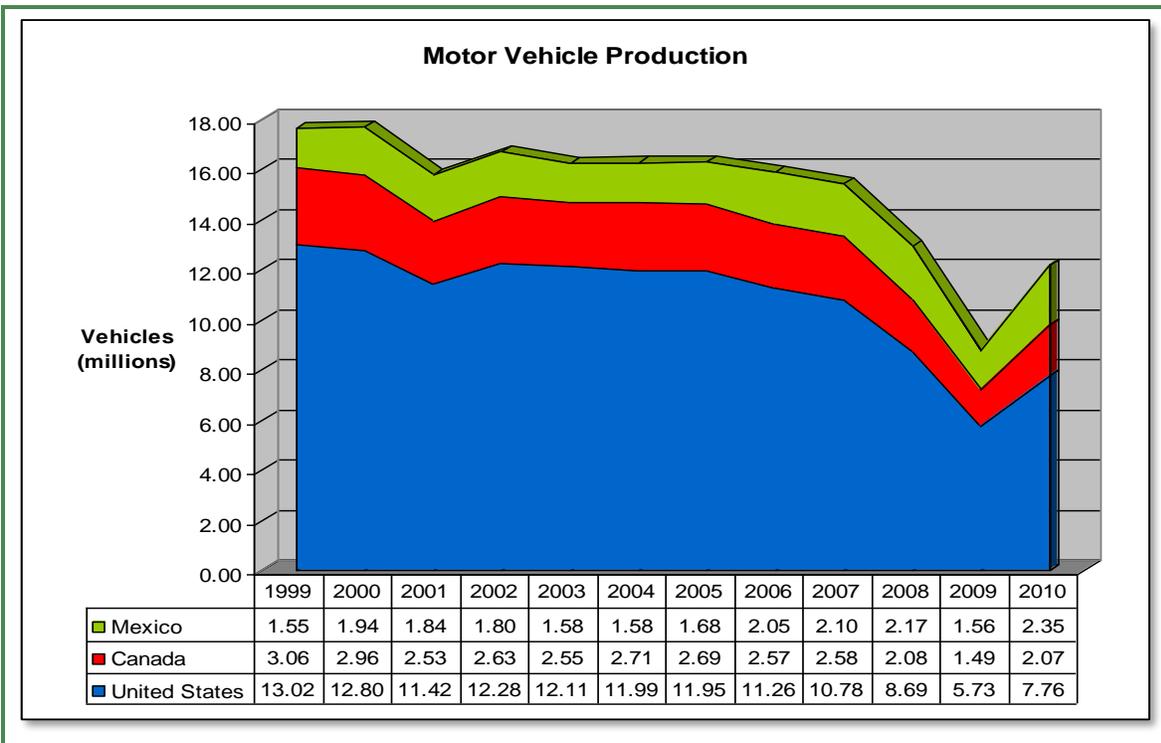
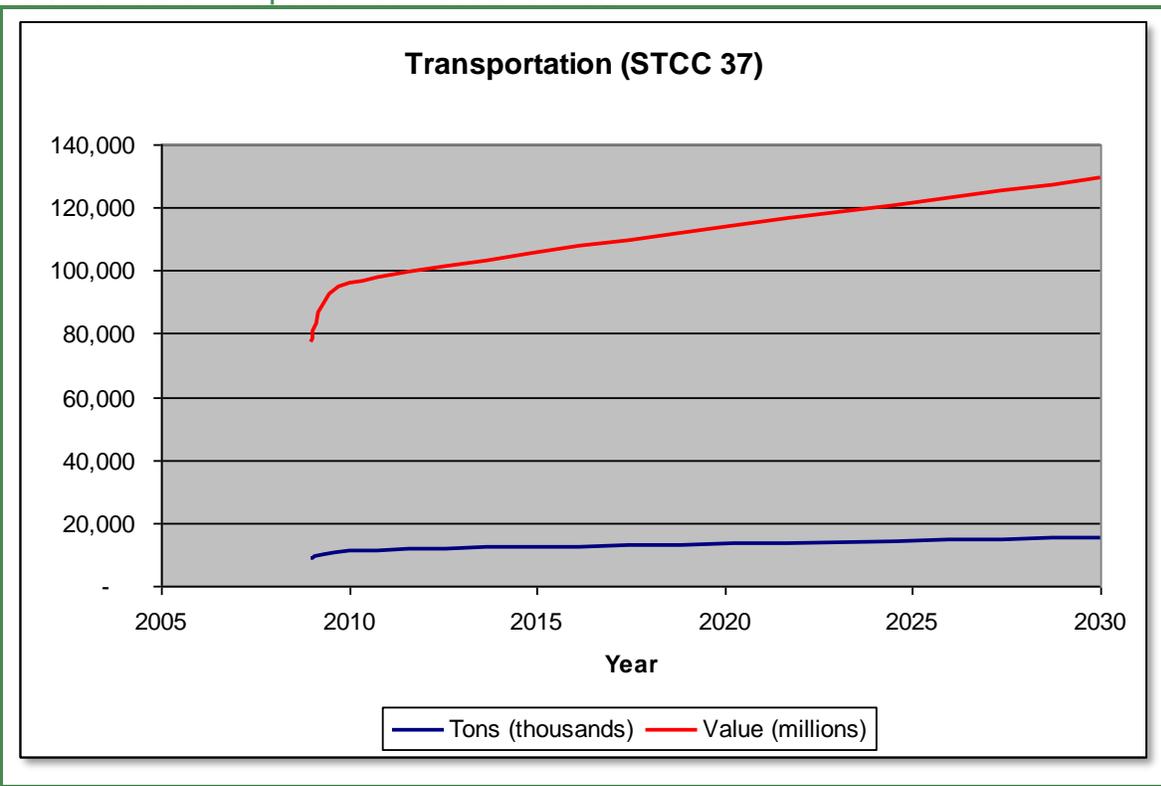


Figure C-2
Transearch Data for Transportation Commodities 2009-2030



ANALYSIS

The Transearch dataset is so detailed, that it must be summarized to be useful for any planning application. For this project, the data have been summarized using TransCAD's software platform, as this is consistent with both SEMCOG and MDOT planning and modeling systems. The basic steps involved are shown below

DATA PROCESSING IN TRANSCAD

1. The native file format for the Transearch data was in MS Access and the embedded tables were imported into a set of TransCAD bin files.
2. A point geographic file was created that corresponds to the 470 Transearch locations (Figure C-3).
3. The flow data records were summarized from 430 detailed commodity classifications into thirty one 2-digit STCC summary-level tables (Table C-1). Note that there is a unique table created for each 2-digit STCC commodity class, year, mode, and for each measure... tons, units, dollars.

Table C-1
2-Digit STCC Code Commodity Description

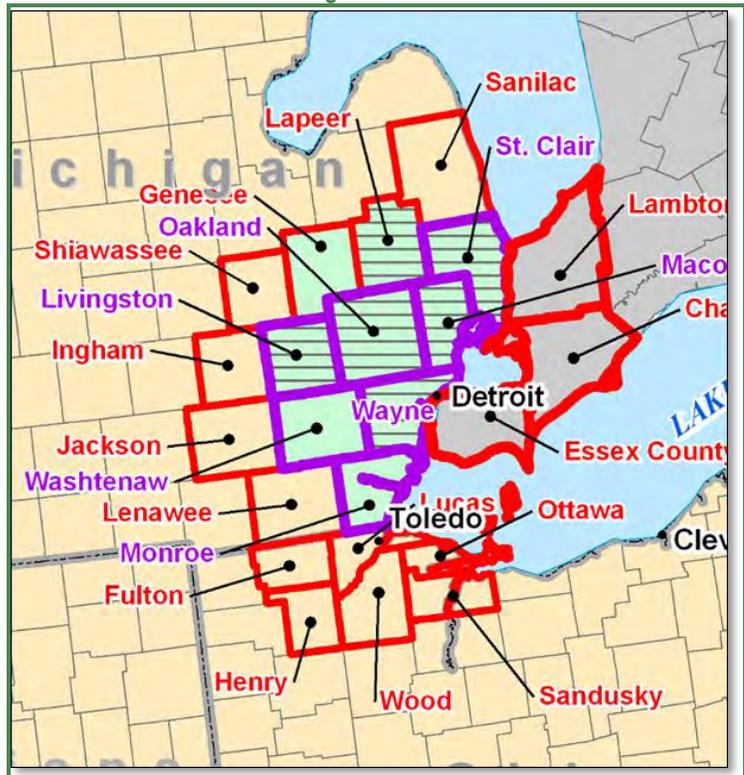
1 Farm products	28 Chemicals or allied products
8 Forest products	30 Rubber or miscellaneous plastics products
9 Fresh fish	31 Leather or leather products
10 Metallic ores	32 Clay, concrete, glass, or stone products
11 Coal	33 Primary metal products
13 Crude petroleum, natural gas or gasoline	29 Petroleum or coal products
14 Nonmetallic ores, minerals, excluding fuels	34 Fabricated metal products
19 Ordnance or accessories	35 Machinery, excluding electrical
20 Food and kindred products	36 Electrical machinery, equipment, or supplies
21 Tobacco products, excluding insecticides	37 Transportation equipment
22 Textile mill products	38 Instruments, photographic goods, optical goods, watches, or clocks
23 Apparel or other finished textile products or knit apparel	39 Miscellaneous products of manufacturing
24 Lumber or wood products, excluding furniture	40 Waste or scrap materials not identified by producing industry
25 Furniture or fixtures	41 Miscellaneous freight shipments
26 Pulp, paper, or allied products	42 Containers, carriers or devices, shipping, returned empty
27 Printed matter	

4. The origin-destination flow tables were converted to a 470 x 470 (location-to-location) matrix in TransCAD. Note that there is a unique matrix created for each 2-digit STCC commodity class, year, mode, and for each measure... tons, units, dollars.
5. The matrices were then summarized into 7 study area geographic categories by using the re-indexing and aggregation procedures contained in the TransCAD software. The seven geographic categories include: SEMCOG counties, Detroit Economic Region (Figure C-4), Remainder of Michigan, Adjacent U.S. State, USA Remainder, Canada, and Mexico.
6. The summary matrices were imported into MS Excel to be further summarized into tables and graphs.
7. SEMCOG should note that there are an infinite number of other ways to summarize the data, but it will be very labor intensive and should only be done in cases where there is a specific application for the more detailed data (corridor study, facility analysis, market analysis).

Figure C-3
 North American Locations Matching Transearch Location Codes



Figure C-4
 Detroit Extended Economic Region



QUANTITY AND VALUE OF SHIPMENTS

The processed Transearch data are summarized in the following sections. Tables C-2 and C-3 show the tonnages of each 2-digit STCC commodity class for 2009 and 2030, respectively. Figures C-5 and C-6 show only the top ranked items. When evaluating the top ranked commodities by tonnage, the categories are dominated by bulk shipments of raw materials or fuels. Although, there is growth in each category, the relative pattern is consistent between 2009 and 2030.

Tables C-4 and C-5 show the total shipment values of each 2-digit STCC commodity class for 2009 and 2030, respectively. Figures C-7 and C-8 present only the top ranked items by value. When evaluating the top ranked commodities by value, the categories are dominated by transportation equipment (as expected) and several other value-added manufactured products. And, as seen above, there is growth in each category, the relative pattern is consistent between 2009 and 2030.

ORIGINS, DESTINATIONS, AND MODES USED

The general geographic patterns for Detroit area freight movements are shown in Figures C-9 and C-10. Roughly half of all freight movements involve origins or destinations in Michigan or adjacent states. As expected, Canada and Mexico represent a significant portion of the freight locations. Forecasts show similar geographical patterns.

Modes used for shipments to the various regions are shown in Figures C-11 through C-14. The truck mode is dominant in both base and forecast environments. In general, the larger shares for rail shipments by value are for more distant destinations, but also, for crossing the border from Canada.

FREIGHT FLOW OPTIONS AND ADDITIONAL INFORMATION SOURCES

The Transearch data, described in the sections above, benchmark existing spatial relationships and form a basis to evaluate trends. The dataset contains highly detailed information, and a great deal potential exists for looking at specific supply chain relationships (e.g., auto industry reliance on cross border movements to Canada, movements of containerized shipments from various ports of entry, distribution of goods to nearby markets, etc.). Corridor flows, based on network traffic assignments have been developed by MDOT from previous versions of this dataset, and may be particularly useful for project prioritization efforts (tonnages and values of commodities moving over one corridor vs. another competing for scarce fiscal resources).

Table C-2
Tonnage 2009

Annual Tons (in thousands) Shipped in the Greater Detroit Region

STCC Code Commodity description	Inbound	Outbound	Total	PCT	Rank
1 Farm products	10,139	4,457	14,596	1.0%	6
8 Forest products	2	3	5	0.0%	31
9 Fresh fish	28	3	31	0.0%	30
10 Metallic ores	2,164	389	2,553	0.2%	17
11 Coal	3,103	8,820	11,923	0.9%	7
13 Crude petroleum, natural gas or gasoline	15,547	15,283	30,830	2.2%	2
14 Nonmetallic ores, minerals, excluding fuels	36,152	26,606	62,758	4.5%	1
19 Ordnance or accessories	32	21	53	0.0%	28
20 Food and kindred products	11,014	6,384	17,398	1.2%	4
21 Tobacco products, excluding insecticides	40	1	40	0.0%	29
22 Textile mill products	135	52	188	0.0%	26
23 Apparel or other finished textile products or knit apparel	230	17	247	0.0%	25
24 Lumber or wood products, excluding furniture	3,513	2,257	5,770	0.4%	11
25 Furniture or fixtures	586	109	695	0.0%	22
26 Pulp, paper, or allied products	2,083	3,609	5,692	0.4%	12
27 Printed matter	1,145	745	1,890	0.1%	19
28 Chemicals or allied products	5,719	5,292	11,011	0.8%	8
30 Rubber or miscellaneous plastics products	1,542	1,210	2,752	0.2%	15
31 Leather or leather products	49	9	58	0.0%	27
32 Clay, concrete, glass, or stone products	9,253	6,119	15,373	1.1%	5
33 Primary metal products	5,571	4,019	9,590	0.7%	9
29 Petroleum or coal products	10,680	11,781	22,461	1.6%	3
34 Fabricated metal products	1,964	1,625	3,589	0.3%	14
35 Machinery, excluding electrical	1,446	1,160	2,606	0.2%	16
36 Electrical machinery, equipment, or supplies	1,389	634	2,023	0.1%	18
37 Transportation equipment	3,300	5,778	9,078	0.7%	10
38 Instruments, photographic goods, optical goods, watches, or clocks	257	91	348	0.0%	24
39 Miscellaneous products of manufacturing	381	192	572	0.0%	23
40 Waste or scrap materials not identified by producing industry	1,717	3,462	5,179	0.4%	13
41 Miscellaneous freight shipments	1,214	309	1,523	0.1%	20
42 Containers, carriers or devices, shipping, returned empty	536	831	1,367	0.1%	21
Total			242,202		

**Table C-3
Tonnage 2030**

Annual Tons (in thousands) Shipped in the Greater Detroit Region

STCC Code Commodity description	Inbound	Outbound	Total	PCT	Rank
1 Farm products	16,885	7,423	24,308	1.7%	6
8 Forest products	3	6	8	0.0%	31
9 Fresh fish	47	5	52	0.0%	30
10 Metallic ores	3,604	648	4,252	0.3%	17
11 Coal	5,167	14,688	19,855	1.4%	7
13 Crude petroleum, natural gas or gasoline	25,891	25,451	51,342	3.7%	2
14 Nonmetallic ores, minerals, excluding fuels	60,206	44,308	104,514	7.5%	1
19 Ordnance or accessories	54	35	89	0.0%	28
20 Food and kindred products	18,342	10,632	28,973	2.1%	4
21 Tobacco products, excluding insecticides	66	1	67	0.0%	29
22 Textile mill products	226	87	313	0.0%	26
23 Apparel or other finished textile products or knit apparel	383	29	412	0.0%	25
24 Lumber or wood products, excluding furniture	5,850	3,759	9,609	0.7%	11
25 Furniture or fixtures	976	181	1,158	0.1%	22
26 Pulp, paper, or allied products	3,469	6,011	9,480	0.7%	12
27 Printed matter	1,906	1,241	3,148	0.2%	19
28 Chemicals or allied products	9,524	8,813	18,336	1.3%	8
30 Rubber or miscellaneous plastics products	2,569	2,015	4,584	0.3%	15
31 Leather or leather products	82	15	97	0.0%	27
32 Clay, concrete, glass, or stone products	15,410	10,191	25,601	1.8%	5
33 Primary metal products	9,277	6,694	15,971	1.1%	9
29 Petroleum or coal products	17,786	19,619	37,406	2.7%	3
34 Fabricated metal products	3,271	2,706	5,978	0.4%	14
35 Machinery, excluding electrical	2,409	1,931	4,340	0.3%	16
36 Electrical machinery, equipment, or supplies	2,314	1,055	3,369	0.2%	18
37 Transportation equipment	5,013	10,105	15,118	1.1%	10
38 Instruments, photographic goods, optical goods, watches, or clocks	428	152	579	0.0%	24
39 Miscellaneous products of manufacturing	634	320	953	0.1%	23
40 Waste or scrap materials not identified by producing industry	2,859	5,766	8,625	0.6%	13
41 Miscellaneous freight shipments	2,022	515	2,537	0.2%	20
42 Containers, carriers or devices, shipping, returned empty	893	1,384	2,277	0.2%	21
Total			403,348		

Figure C-5
2009 Top 10 Commodities by Annual Tonnage

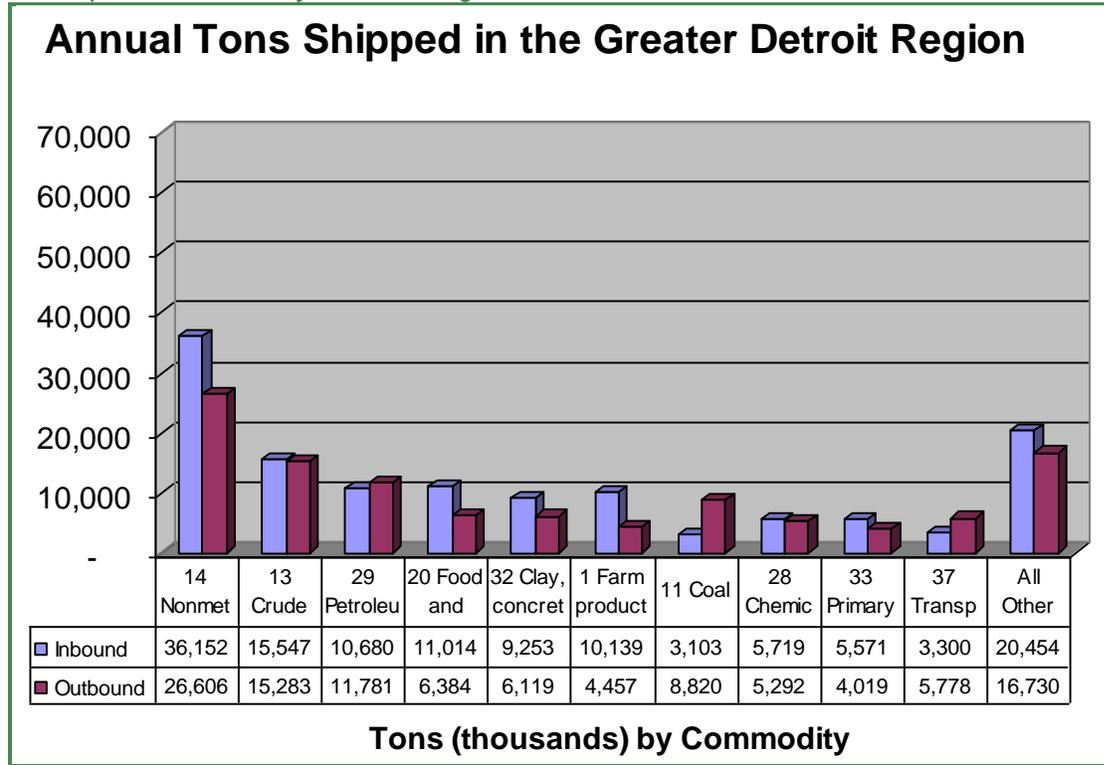


Figure C-6
2030 Top 10 Commodities by Annual Tonnage

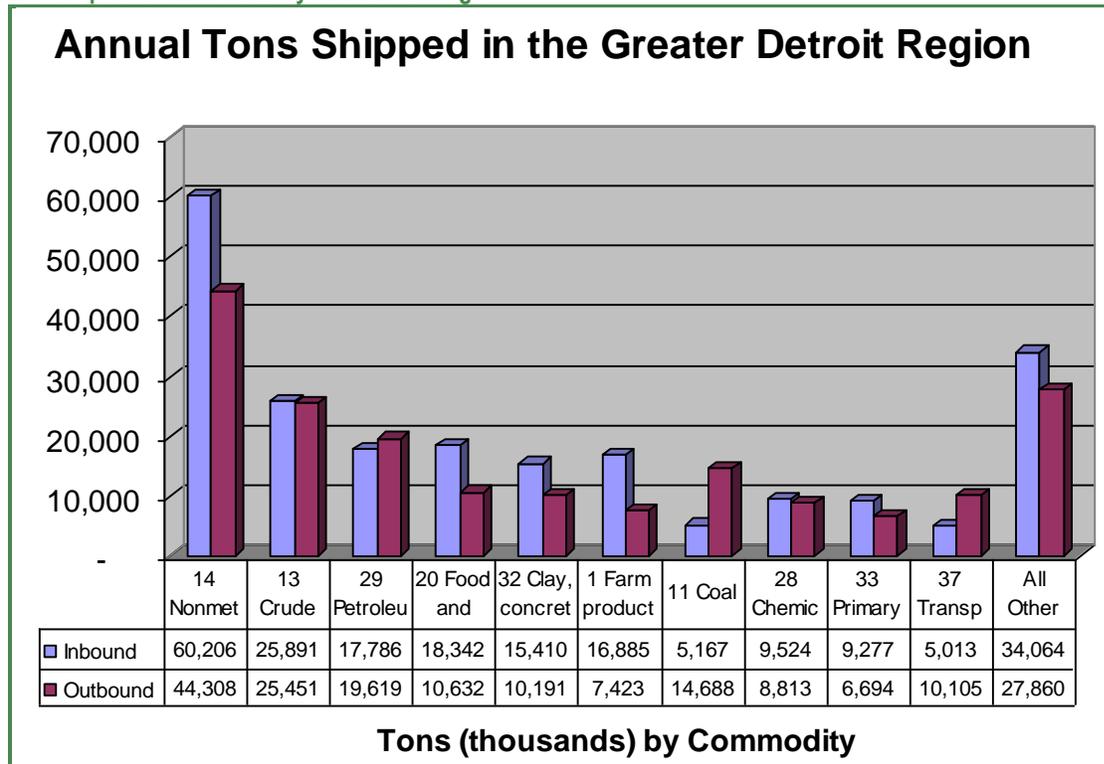


Table C-4
Value 2009

Annual Value (in millions \$) Shipped in the Greater Detroit Region

STCC code Commodity description	Inbound	Outbound	Total	PCT	Rank
1 Farm products	4,150	1,491	5,642	2.1%	11
8 Forest products	3	6	8	0.0%	31
9 Fresh fish	132	13	145	0.1%	30
10 Metallic ores	148	38	186	0.1%	29
11 Coal	148	439	587	0.2%	27
13 Crude petroleum, natural gas or gasoline	3,380	1,793	5,173	2.0%	12
14 Nonmetallic ores, minerals, excluding fuels	456	412	868	0.3%	24
19 Ordnance or accessories	827	453	1,280	0.5%	22
20 Food and kindred products	11,650	5,445	17,094	6.5%	5
21 Tobacco products, excluding insecticides	556	7	563	0.2%	28
22 Textile mill products	591	274	865	0.3%	25
23 Apparel or other finished textile products or knit apparel	2,049	110	2,159	0.8%	21
24 Lumber or wood products, excluding furniture	1,668	927	2,595	1.0%	20
25 Furniture or fixtures	2,550	520	3,071	1.2%	19
26 Pulp, paper, or allied products	2,389	4,192	6,581	2.5%	10
27 Printed matter	3,066	2,047	5,113	1.9%	13
28 Chemicals or allied products	10,139	8,777	18,916	7.2%	4
30 Rubber or miscellaneous plastics products	5,352	3,687	9,038	3.4%	9
31 Leather or leather products	736	46	782	0.3%	26
32 Clay, concrete, glass, or stone products	2,336	1,130	3,466	1.3%	16
33 Primary metal products	8,858	4,999	13,857	5.3%	6
29 Petroleum or coal products	5,536	4,876	10,412	4.0%	8
34 Fabricated metal products	6,088	5,490	11,578	4.4%	7
35 Machinery, excluding electrical	12,750	10,727	23,478	8.9%	3
36 Electrical machinery, equipment, or supplies	19,272	7,046	26,319	10.0%	2
37 Transportation equipment	26,096	51,096	77,192	29.3%	1
38 Instruments, photographic goods, optical goods, watches, or clocks	3,152	1,505	4,657	1.8%	14
39 Miscellaneous products of manufacturing	2,319	946	3,265	1.2%	17
40 Waste or scrap materials not identified by producing industry	328	543	870	0.3%	23
41 Miscellaneous freight shipments	2,845	1,248	4,092	1.6%	15
42 Containers, carriers or devices, shipping, returned empty	1,272	1,971	3,243	1.2%	18
Total			263,096		

Table C-5
Value 2030

Annual Value (in millions \$) Shipped in the Greater Detroit Region

STCC code Commodity description	Inbound	Outbound	Total	PCT	Rank
1 Farm products	7,155	2,571	9,726	2.2%	11
8 Forest products	5	10	14	0.0%	31
9 Fresh fish	228	22	250	0.1%	30
10 Metallic ores	255	65	320	0.1%	29
11 Coal	255	757	1,012	0.2%	27
13 Crude petroleum, natural gas or gasoline	5,827	3,091	8,918	2.0%	12
14 Nonmetallic ores, minerals, excluding fuels	786	710	1,497	0.3%	24
19 Ordnance or accessories	1,425	781	2,206	0.5%	22
20 Food and kindred products	20,085	9,387	29,472	6.5%	5
21 Tobacco products, excluding insecticides	959	13	971	0.2%	28
22 Textile mill products	1,019	473	1,492	0.3%	25
23 Apparel or other finished textile products or knit apparel	3,533	190	3,723	0.8%	21
24 Lumber or wood products, excluding furniture	2,876	1,599	4,475	1.0%	20
25 Furniture or fixtures	4,397	897	5,294	1.2%	19
26 Pulp, paper, or allied products	4,119	7,227	11,345	2.5%	10
27 Printed matter	5,286	3,528	8,815	2.0%	13
28 Chemicals or allied products	17,480	15,132	32,612	7.2%	4
30 Rubber or miscellaneous plastics products	9,227	6,356	15,583	3.5%	9
31 Leather or leather products	1,269	79	1,348	0.3%	26
32 Clay, concrete, glass, or stone products	4,027	1,949	5,976	1.3%	16
33 Primary metal products	15,271	8,619	23,890	5.3%	6
29 Petroleum or coal products	9,545	8,406	17,951	4.0%	8
34 Fabricated metal products	10,497	9,465	19,962	4.4%	7
35 Machinery, excluding electrical	21,982	18,495	40,477	9.0%	3
36 Electrical machinery, equipment, or supplies	33,227	12,148	45,375	10.1%	2
37 Transportation equipment	39,833	89,688	129,521	28.8%	1
38 Instruments, photographic goods, optical goods, watches, or clocks	5,434	2,595	8,029	1.8%	14
39 Miscellaneous products of manufacturing	3,998	1,631	5,629	1.3%	17
40 Waste or scrap materials not identified by producing industry	565	936	1,501	0.3%	23
41 Miscellaneous freight shipments	4,904	2,151	7,056	1.6%	15
42 Containers, carriers or devices, shipping, returned empty	2,193	3,398	5,591	1.2%	18
Total			450,030		

Figure C-7
2009 To 10 Commodities by Value

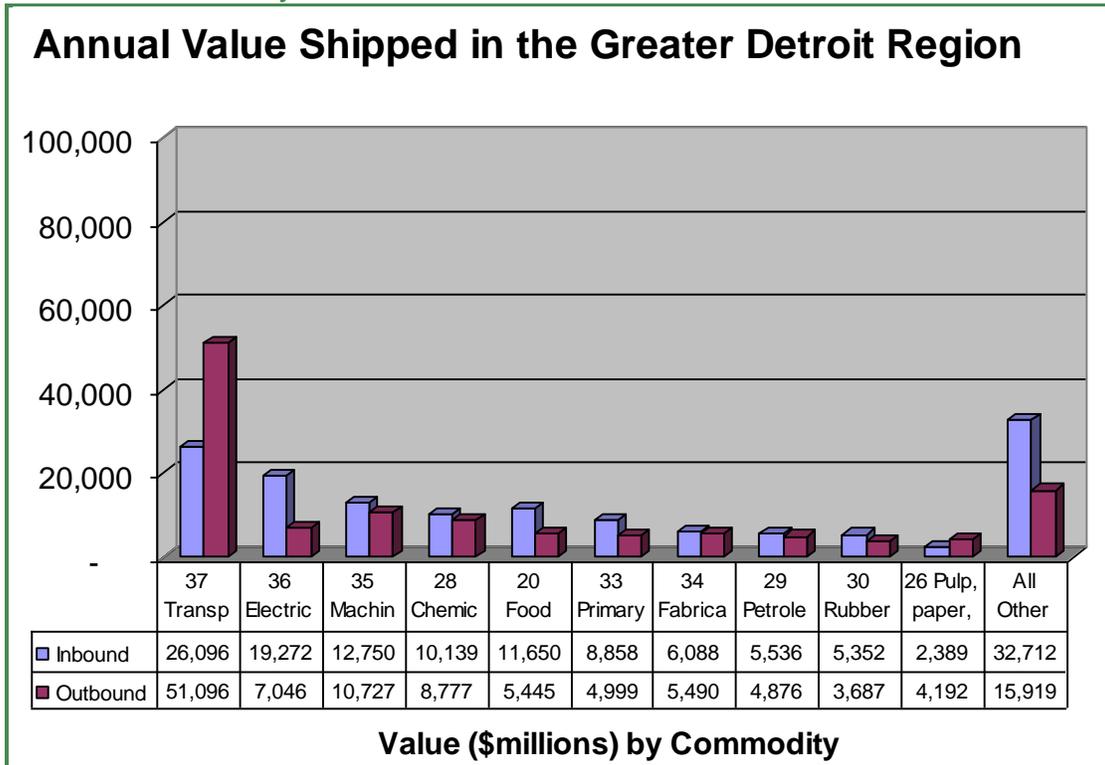


Figure C-8
2030 Top 10 Commodities by Value

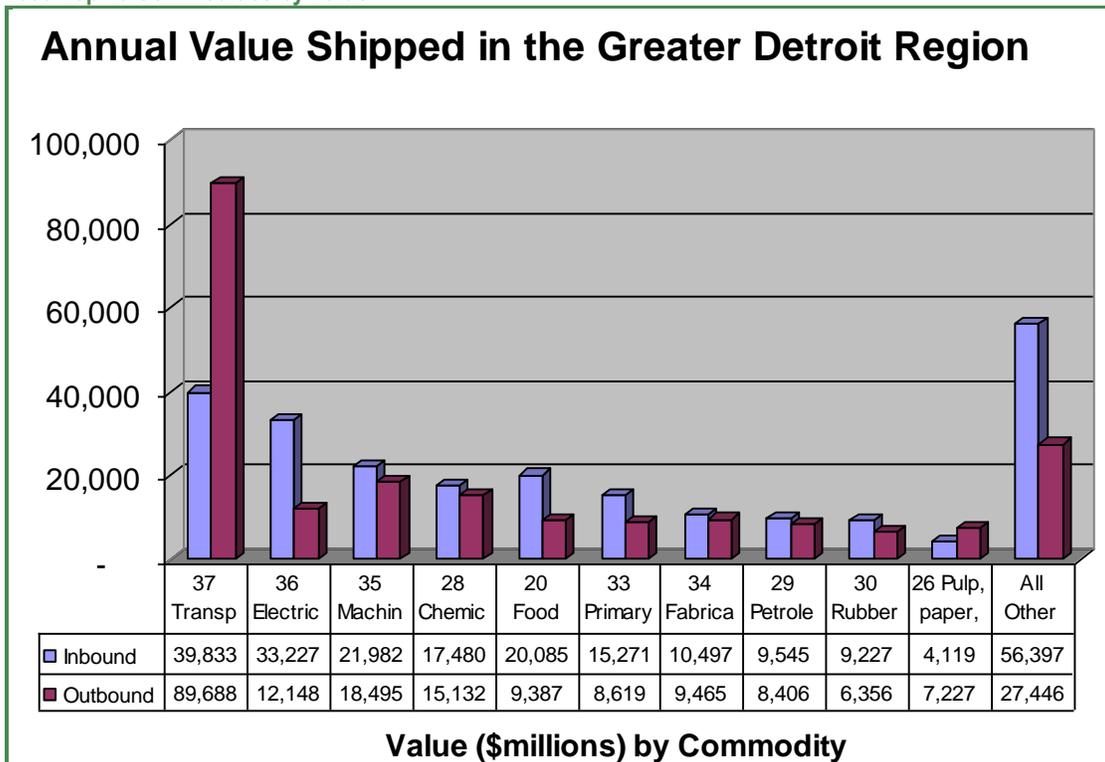


Figure C-9
2009 Inbound and Outbound Trip Origins and Destinations

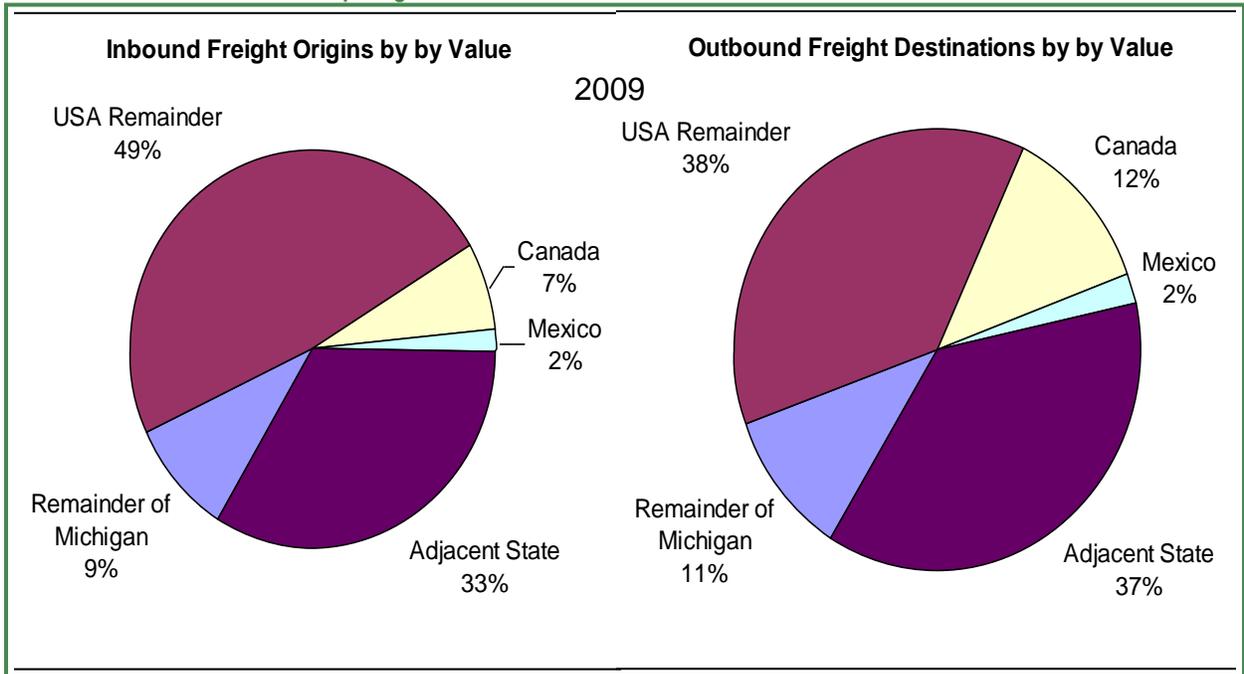


Figure C-10
2030 Inbound and Outbound Trip Origins and Destinations

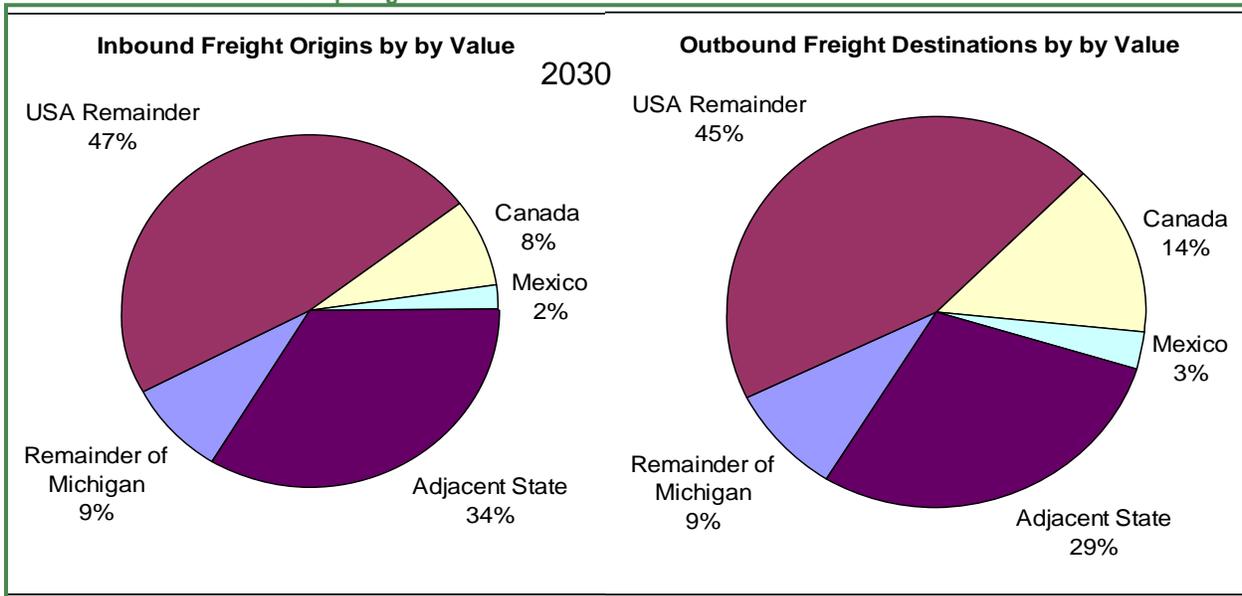


Figure C-11
2009 Outbound by Mode and Destination Region

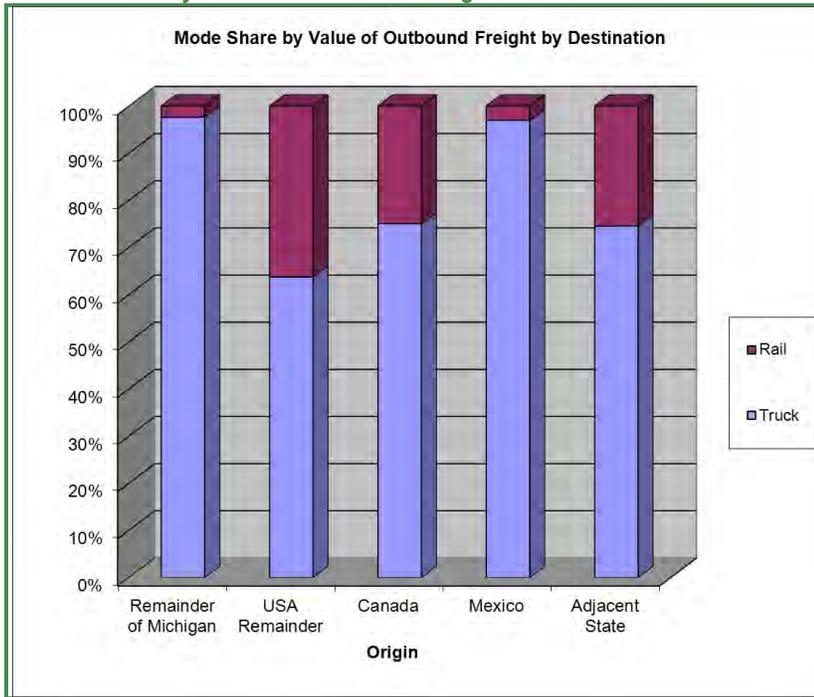


Figure C-12
2009 Inbound by Mode and Destination Region

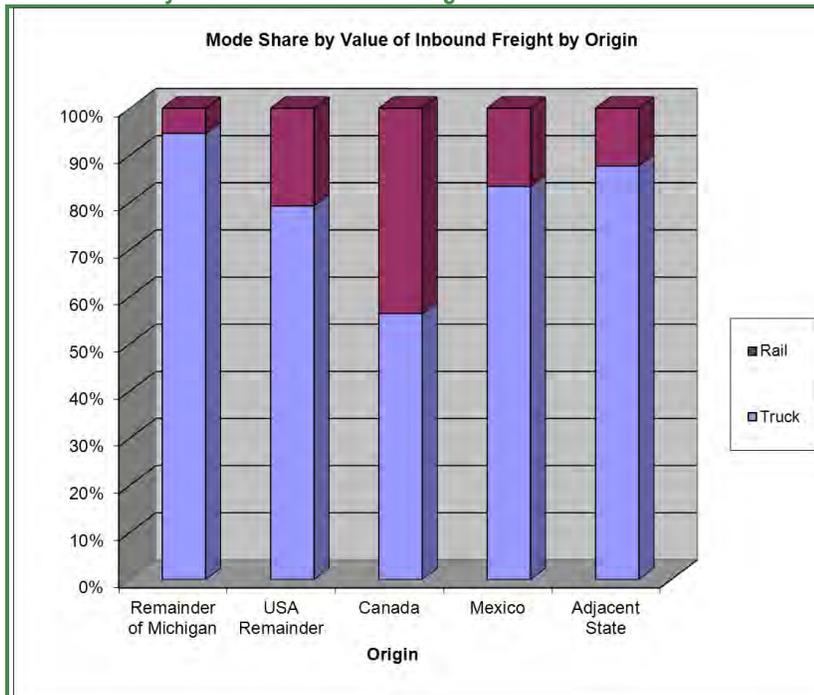


Figure C-13
2030 Outbound by Mode and Destination Region

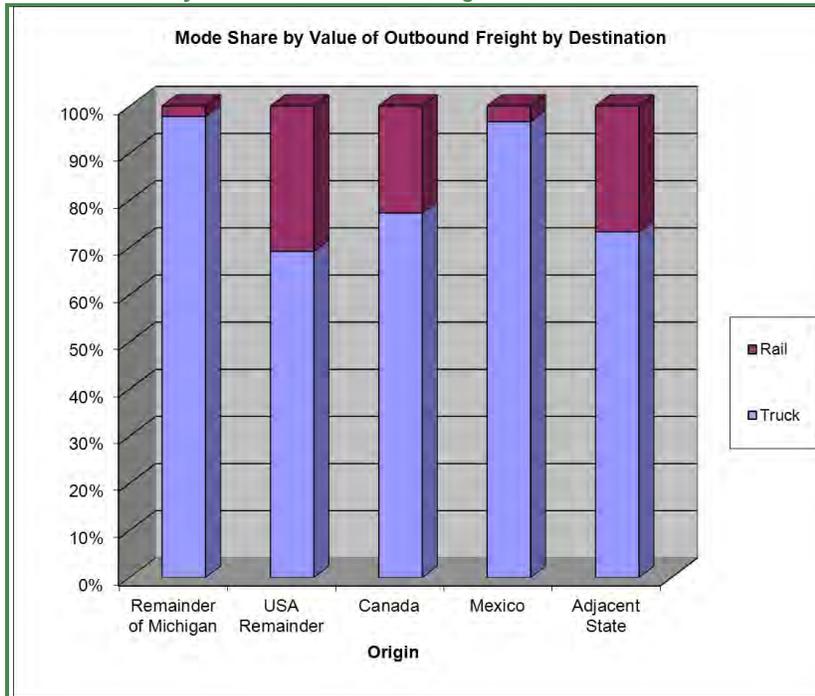
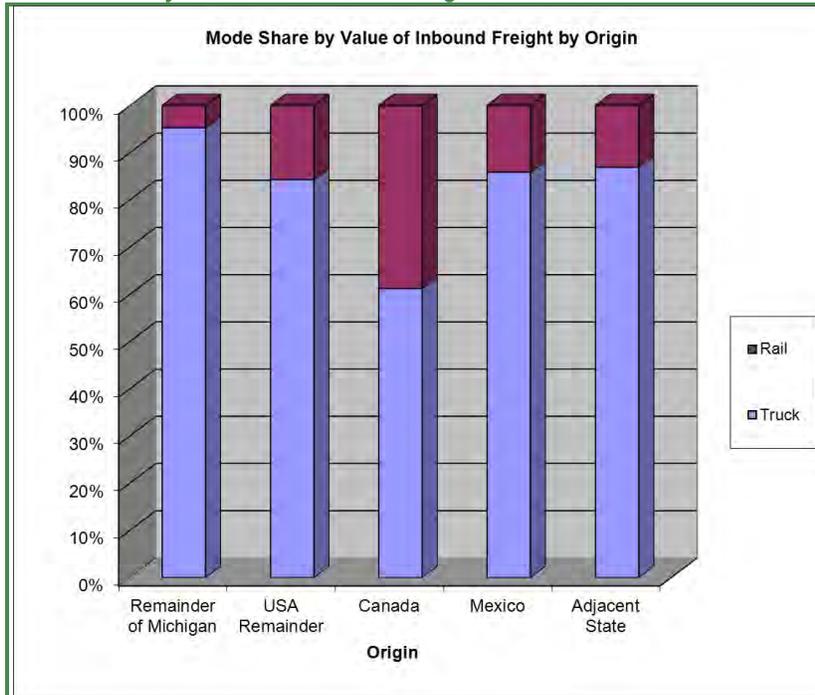


Figure C-14
2030 Inbound by Mode and Destination Region



In addition to the Transearch data, there are a variety of other freight flow datasets that may prove to be useful for freight planning efforts.

Freight Flow Products:

- SEMCOG Commercial Vehicle Model
- Global Insight freight data are available from MDOT for multiple years, 2009 is the most recent (2003 and 2006 are available too). This dataset includes highway and rail flows by commodity (corridor specific).
- MDOT Highway Freight Assignment Network
- Freight Analysis Framework (FAF3) – The FHWA Freight Analysis Framework (FAF) integrates data from a variety of sources to create a comprehensive picture of freight movement among states and major metropolitan areas by all modes of transportation. With data from the 2007 Commodity Flow Survey and additional sources, FAF Version 3 (FAF3) provides estimates for tonnage and value, by commodity type, mode, origin, and destination for 2007, the most recent year, and forecasts through 2040. Also included are truck flows assigned to the highway network for 2007 and 2040.

Primary Freight Data

- Bureau of Transportation Statistics Transborder Surface Freight Data include trade information by commodity type, by surface mode of transportation (rail, truck, pipeline, mail and other), and with geographic detail for U.S. exports to and imports from Canada and Mexico for years between 1993-2009
- Border Crossing Traffic Volume includes annual and monthly border-crossing traffic (bridge and tunnel) for 1990-2009. Vehicle type information available is after 1995. This data set includes annual rail traffic.
- MDOT Bluewater Bridge Truck Origin-Destination Survey, 2009.
- SEMCOG Internal Commercial Vehicle Survey 1998
- SEMCOG/MDOT External Commercial Vehicle Survey 1994 and 1996.
- Bureau of Transportation Statistics 2007 Commodity Flow Survey is a stratified sample of shipments across all modes, with details on origin-destination, tonnage, and value of shipments.
- Carload/Waybill Sample is a stratified sample of carload waybills for all U.S. rail traffic submitted by major rail carriers (terminating 4,500 or more revenue carloads annually). The public dataset is available for 2007, 2008, 2009. Because the Waybill Sample contains sensitive shipping and revenue information, access to this information is restricted.

- American Trucking Research Institute (ATRI) has a large national sample of GPS truck traces. This can be expanded and used as another source of origin-destination data.
- National Roadside Survey Canada (NRS) for 1999 and 2006. Includes comprehensive information on truck travel between Canada and the U.S.

Forecast future freight flows by corridor, mode, and commodity:

- SEMCOG travel model, which has freight forecasting capabilities. This is being updated by SEMCOG now, and the latest version may be available for use in the study.
- FAF3 national forecasts by modes (Truck, Rail, Water, Air, Multiple Modes & Mail, Pipeline, Other), by 41 commodity classes, by dollar value, and by tonnage.

MDOT has multiple years of Global Insight freight flow forecast data available. MDOT has added value to the information by making it compatible with the statewide travel demand model. The model's highway and rail networks cover the US and Canada.