Missouri River Freight Corridor
Assessment and Development Plan

Market Potential

(Technical Memo 3)

Prepared By

HANSON

Hanson Professional Services, Inc.

MoDOT

Supporting Document Prepared for Missouri Department of Transportation

2011 October | Project TRyy1018 | Report cmr 12 - 006

Preface

Task 3 consisted of collecting freight data information to develop a "baseline" condition for shipping to and from the Missouri River region. Both domestic and international data were gathered for freight moving to and from Missouri by port, trade region, and commodity value to develop a model for Missouri trade. This model serves as a point of reference to analyze the relative freight volume shares of exports and imports of rail and truck by port and commodity.

This effort included:

- The examination and summarization of freight movements to and from the Missouri River Corridor to identify commodity groups (and associated traffic levels) that might be suitable for a shift in transportation mode as well as market locations most likely to shift to water from another mode.

- Analysis of growth projections and trade trends for the potential waterborne freight types.

The resulting effort provides a background understanding of the potential freight markets, volumes, locations, and general logistical needs of the Missouri River region. This information is part of establishing overall river development strategies that build the concepts of operation. Subsequent steps included:

1. Using the modeling output to identify specific potential market nodes by commodity

2. Taking the potential market, commodity, cost factors, and node information to the stakeholders, in combination with the inventory information compiled in Task 2, to understand the realities of potential freight shifts and new markets

3. Then using the stakeholder input to run before and after scenarios for particular commodities and market nodes

4. Prioritizing specific potential market opportunities

Further development of market strategy relative to potentially changing world trade patterns (i.e. the expanded Panama Canal) and those impacts relative to the Missouri River was considered in the Task 4 evaluation of market nodes.

Missouri River Freight Corridor Assessment & Development Plan: Task 3

Presented to:

Hanson Professional Services

February 2010

Prepared by:

moffatt & nichol

Table of Contents

1. Purpose

This report addresses Task 3*: Assess Market Potential and Integrate into Overall River Development Approach* of the *Missouri River Freight Corridor Assessment & Development Plan.* Moffatt & Nichol is conducting this segment of the analysis as a Subcontractor to Hanson Professional Services.

The purpose of this study is to identify freight shipments that could *potentially* be routed for at least part of their supply chain to barge on the Missouri River. The implicit assumption of this statement is that there are a significant number of shipments through the region which do not take advantage of lesser cost routing options that are reasonably available.

Decisions failing to minimize costs could be the result of the following causes:

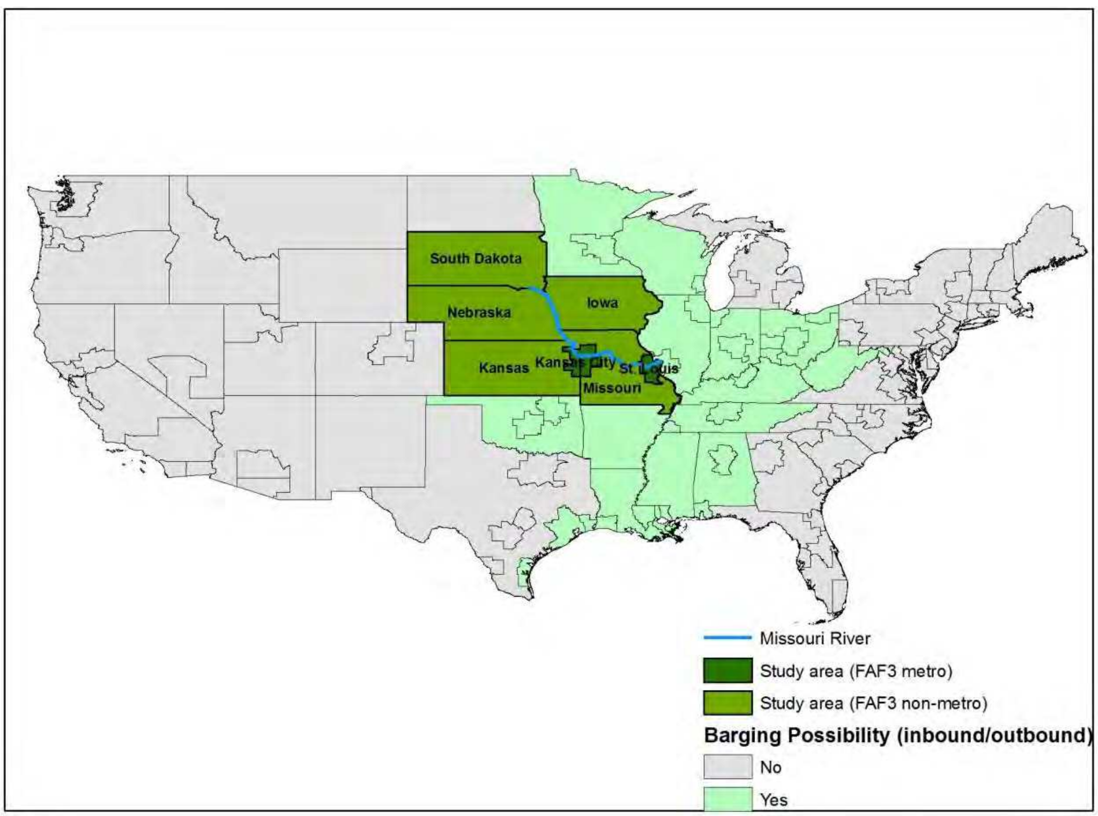
- Lack of knowledge of the structure of transport costs or changes in least cost routing;
- Lack or obscurity of barge services:
- Under-estimation of the size of point-to-point demand by service providers;
- Failure to take into consideration the impact of inventory costs of goods in transit; and
- Other causes of path dependency.

The methodology used in this Task 3 report identifies all point-to-point shipments. Later task analyses will identify new business opportunities versus existing shipments.

2. Executive Summary

This report identifies the addressable market and the drivers of demand for barge services on the Missouri River. Although the Missouri River is the longest river in the US, its most navigable segment is bordered by five states that for the purposes of this study form the region of interest, referred to here as the Missouri River Barge (MRB) region. This region has a broad economic base due to its geography and central location in the US. These factors along with access to other parts of the country via well-developed roadways, railways and waterways are the reasons that a substantial amount of a wide variety of freight is moved within, to and from the MRB region. Despite the fact that the MRB region has a barge-accessible geographical reach that stretches from the Gulf Coast to as far east as West Virginia and as far north as Minnesota, very little of the freight flowing through it is carried on barges. Out of a database of 900,000 identified freight shipments in the MRB region in 2007, about 0.02% or 163 were found to be potential barge shipments based on size, geographic location, type of commodity, trip duration, and trip purpose. This report describes the process through which these types of freight and their barge demand characteristics were identified in the MRB region, as well as the geographical distribution of this demand.

Figure 1: MRB Region (Selected States Denoted in Dark Green)



Source: Moffatt & Nichol

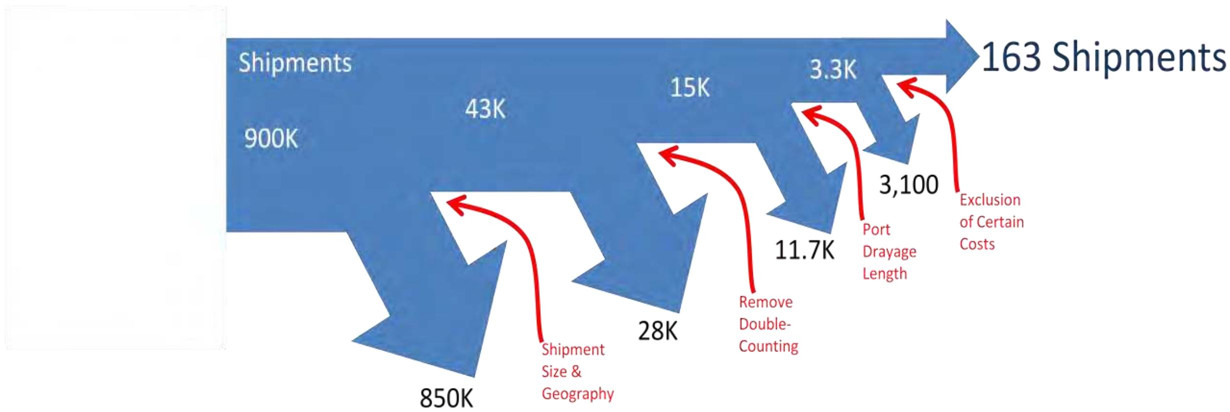
Several databases were used to measure and identify the type of goods flowing through the MRB region. These include the Freight Analysis Framework (FAF) developed by the Federal Highway Administration (FHWA), the 2007 County Business Patterns national survey, the 2007 US Economic Census, and the 2002 Benchmark Input-Output Tables published by the Bureau of Economic Analysis. Additional information such as the inventory carrying costs, as estimated by the Federal Railroad Administration's Intermodal Transportation and Inventory Cost Model (ITIC-IM), were also used in the process of identifying potential barge shipments.

A substantial portion of the analysis in this report focuses on the process of matching the regional goods flows, based on the FAF to the goods producing establishments and supply chain actors within the region via a simulation of the economy developed primarily from the business activity surveys and the Input-Output tables. The first part of this report is devoted to explaining this process and validating the results. The later part of the report highlights the findings.

Identification of Potential Barge Shipments

The analysis of potential barge shipments begins with the initial allocation of FAF shipment data of roughly 900,000 shipments associated with MRB. In order to develop a manageable data set and identify the shipments best suited for barging, four layers of criteria were applied to the modeling process to eliminate those shipments which were not viable either due to shipment size, geography, or cost limitations. Each subsequent iteration generated a smaller and more useful data set which narrowed the number of shipments to until those with the greatest potential for barging remained. Figure 2 illustrates the elimination process and details the basis of each step of elimination.

Figure 2: Process of Elimination



Source: Moffatt & Nichol

The first elimination filtered shipments that were too small to travel by barge, as well as eliminating shipments to/from regions deemed inaccessible via barge. The second elimination removed double-counting of intra-regional shipments. The third filtering eliminated shipments for which the total drayage to and from the water port was deemed too large (it was considered too large if the total dray distance was 40% or greater than the distance needed to simply truck the shipment from origin to destination). The final screening involved removing inventory costs and drayage/handling costs from certain shipments (this will be discussed in greater detail later). After removing the specified costs, the shipments for which barge transportation was estimated as the cheapest (between rail, truck, and barge) were kept.

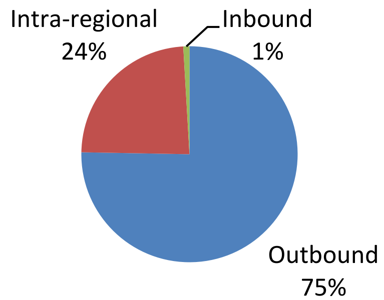
Results

The process of elimination described in this report yielded 163 shipments. Each shipment was distinct in that it represented a commodity flow to or from a shipper/receiver located within the MRB. These shipments were overwhelmingly composed of export goods that originated in MRB.

One more criteria was applied to these 163 shipments once the results were analyzed and that was if the good had moved on the Missouri River. Of the 163 identified, an evaluation of the routing model showed that 42 of these shipments travelled to/from MRB via the Mississippi River and terminated or originated in a county with loading facilities on the Mississippi.

Figure 3 illustrates the type of shipments that make-up the 59 million tonnes (121 shipments) that moved via the Missouri River. Movements with an origin and destination within the MRB (Intra-regional movements) and movements with an origin outside of the MRB but a destination within the MRB (Inbound movements) account for a small share of the potential volumes. On the other hand, movements with an origin in the MRB, but a destination outside of it (Outbound movements) make up the majority of the potential tonnage.

Figure 3: Potential Barge Movement by Shipment Type (% of Total Tonnage)

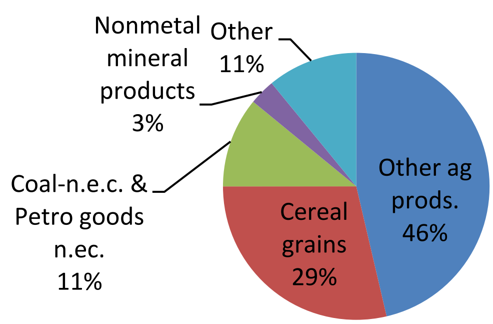


Total Potential Tonnage = 59 million tonnes

Source: Moffatt & Nichol

Figure 4 illustrates the potential shipments broken down by commodity. The majority of the volumes are made up of commodities which are produced/consumed in large quantities and tend to be shipped on irregular schedules due to their high dwell times. These include Other Ag Products (which are primarily soybeans), cereal grains, and coal and petroleum products n.e.c. The absence of manufactured goods – excluding equipment - is due largely to the need for these goods to be shipped on a regular basis, thus their shipment sizes tended to be smaller than bulk goods because the annual shipment quantities were shipped on a weekly basis. Two other factors further limited the suitability of barge as a means of transporting manufactured goods to the region. The first is that most manufactured goods travel in a West-East direction while the Missouri River is most suited to commodities moving North-South. The other is that manufactured goods have the cost of labor imbedded in their purchase price, and thus are more sensitive to inventory carrying costs.

Figure 4: Potential Barge Shipments by Commodity (% of Total Tonnage)



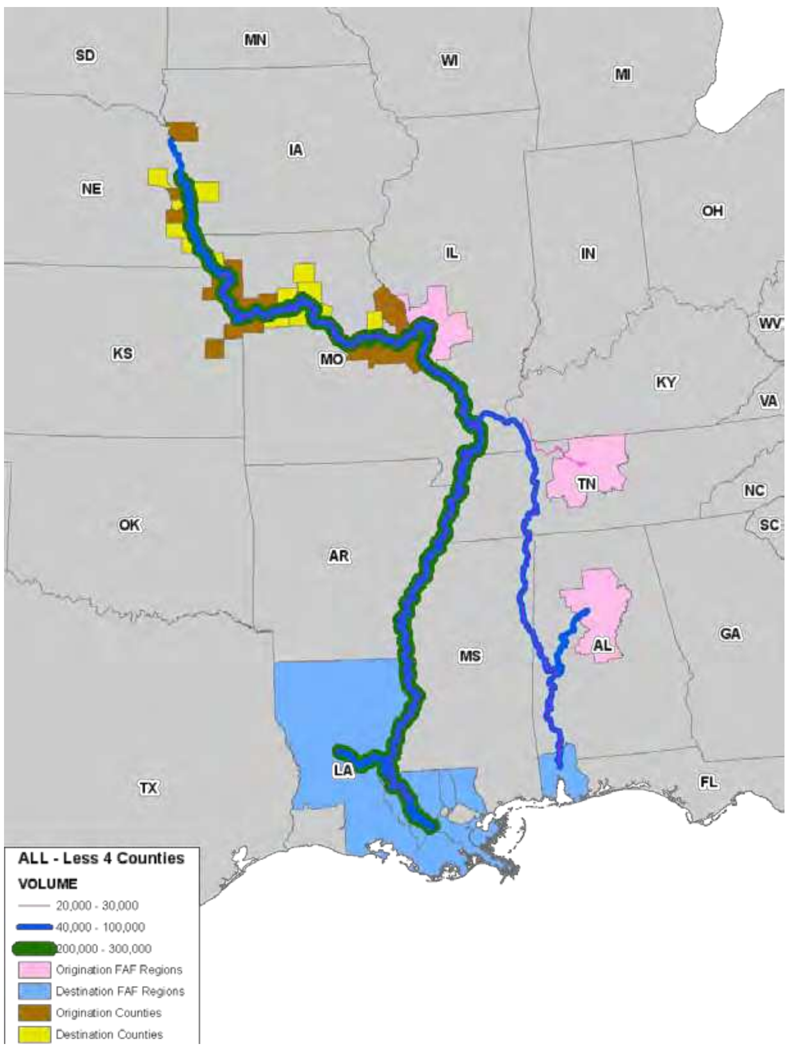
Total Potential Tonnage = 59 million tonnes

Source: Moffatt & Nichol

One other factor that influence the number of potential barge shipments identified through the elimination process was the geographical location of the shipper within MRB.

Figure 5 graphically illustrates the origin, destination and shipping route of the shipments. Within MRB, the origin and destination counties from/to which shipments are made/received (represented in brown and yellow respectively) are located adjacent to or in very close proximity to the Missouri River. This highlights the impact of the additional transportation cost required to reach inland destinations which increases the cost of barging vs. other modes of transportation. For inter-regional shipments, the destination of Outbound shipments from MRB are shown in blue while the origin of Inbound shipments to MRB are shown in pink.

Figure 5: Heat Map of Potential Shipments



Source: Moffatt & Nichol

Conclusions

Moffatt & Nichol identified 121 shipments that could *potentially* be routed for at least part of their supply chain to barge on the Missouri River.

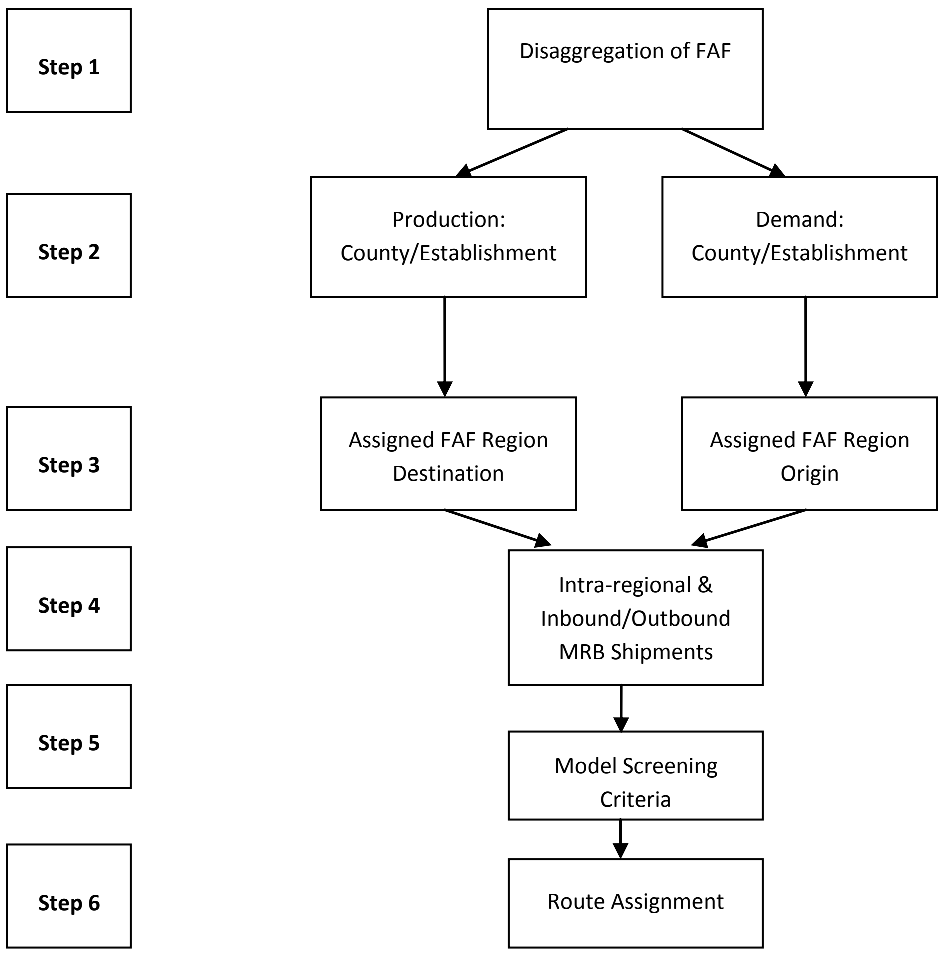
Three characteristics regarding potential barge movements emerged from the analysis:

- The shipper or receiver should be located on the water. The cost and time associated with drayage/handling between a port and an off water facility tends to make barge less affordable.
- Shipment sizes must be sufficiently large in order to utilize barge capacity (for bulk shipments).
- Because barge is a much slower mode of transport, the shipment must be capable of absorbing inventory carrying costs accrued en route.

3. Model Flow

The model process and the significant assumptions are addressed in detail throughout the first four chapters of the report. Figure 6 provides a graphic illustration of the basic structure to the modeling process.

Figure 6: Model Flow Diagram of M&N Approach



Source: Moffatt & Nichol

This approach, which includes the disaggregation and reallocation of FAF, is similar to freight modeling approaches previously implemented by state DOTs. Two examples of this include the Statewide Models developed for Michigan and Wisconsin respectively.

Michigan Statewide Truck Model (1998 used 1997 CFS data)

- Attempts to equate value of goods shipments per 1000 employees of the generating industry
- Trip generation and destination was carried out at the Commodity Analysis Zone (CAZ) and allocated to the counties using the employment by industry
- Destination choice model was used to allocate trip origins. This model was mathematically equivalent to a simple constrained gravity model
- The number of truck loads was determined by dividing the total shipment tonnage by the average freight load of a truck

Wisconsin Statewide Model (2007 Transearch Data)

- Total production, in tons per employee by industry, is calculated at the state level
- Production is then allocated to the county level using the CBP data, by taking the county share of total employment
- Additional disaggregation of production to the Commodity Analysis Zone (CAZ) within each county is done using the population at that level
- State level input-output accounts were used to derive attractions for business and households. Allocation to the country level was conducted using the share of consuming industries designated in the CBP data.
- A gravity model was used to distribute trips into three classifications: internal, internal-external, and external internal.

4. Use of FAF Data

In the simulation of commodity flows through the MRB region, Moffatt & Nichol uses the FAF3 data as the control total. This data set has been disaggregated, and the commodity flow totals within the MRB study region have been reallocated to the county level from the larger FAF regions.

The FAF data has been widely accepted and incorporated into other freight movement analysis. Two examples include, "The Delaware Valley Regional Planning Commission developed tables from the FAF2 origin-destination database to illustrate domestic and foreign freight flows into the Philadelphia region," and "The FAF2 origin-destination database was used to develop estimates of internal-external and through truck trips for a truck model of the San Diego region" (Donnelly).

FAF 3 is the third version of the FAF database, first developed in 1997-1999. "FAF3 is a Federal Highway Administration (FHWA) funded and managed data and analysis program that provides estimates of the total volumes of freight moved into, out of and within the United States, between individual states, major metropolitan areas, sub-state regions, and major international gateways" (Southworth).

Working with a base year of 2007, FAF3 uses multiple sources of data including the 2007 Commodity Flow Survey, the Surface Transportation Board's public use railcar waybills, the US Army Corps of Engineers Waterborne commerce dataset and also calls upon other datasets, such as PIERS data.

The main data products of FAF are:

- "A set of annual freight flow matrices, reported in annual tonnages and annual dollar value of goods transported, for calendar year 2007 for the United States,
- Based on these base year flow estimates, a set of forecast year freight flow matrices, projected out to calendar year 2040,
- A set of annual freight tonnage and vehicle/vessel movement volumes assigned to specific links and routes over the United States multimodal truck-rail-waterways transportation network, based on these base year 2007 and forecast year 2040 flow estimates."

"Based on these estimated freight flows and their network assignments, a set of annual freight tonnage, dollar value, and ton-mileage statistics, broken down by mode of transport and commodity class are also developed" (Southworth).

5. Methodology

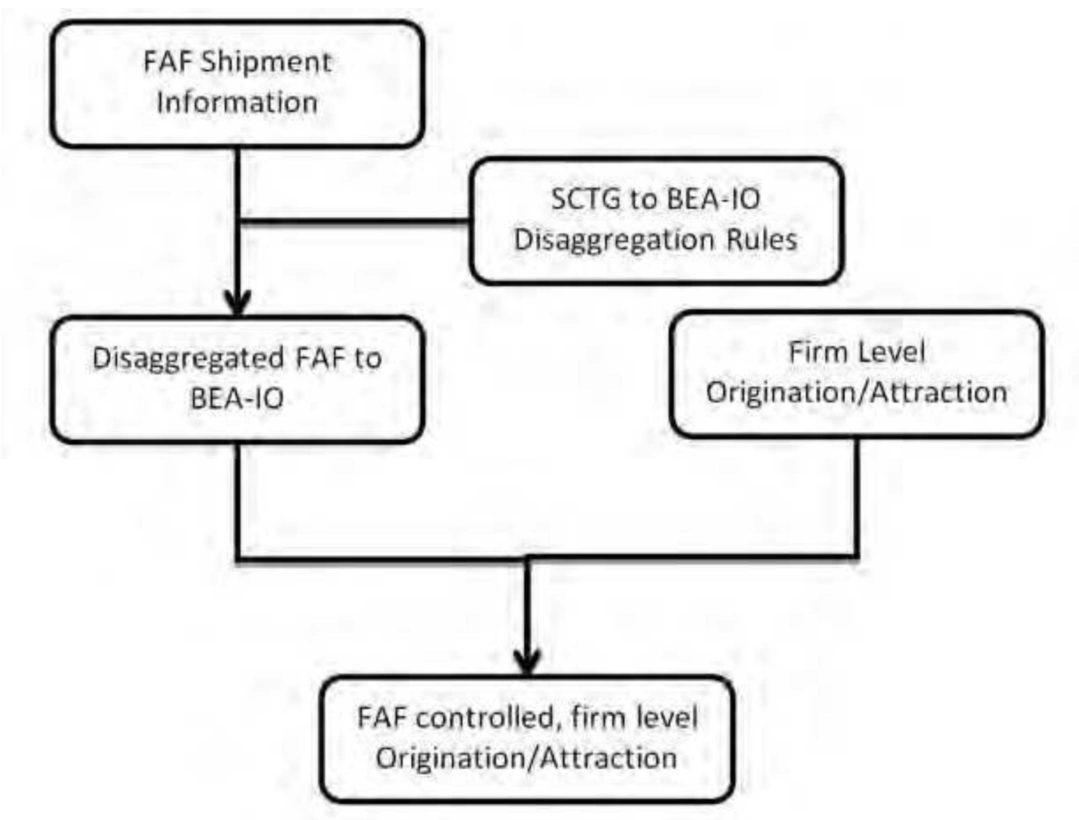
5.1.Disaggregation of FAF

The first step in generating firm level routings is to disaggregate the FAF shipment information from SCTG to BEA-IO codes. The disaggregation of FAF data from SCTG to BEA-IO codes leads to higher level granularity in the analysis. At this higher level each commodity is treated differently and commodity specific results are created. The disaggregated FAF shipments are used to control commodity production of the economic simulator to create FAF controlled, firm level Origination/Attraction information.

This ability to analyze commodity specific routings is necessary to study the impact of different scenarios on individual products in a manner aimed at understanding how different markets are affected with different policies.

The flow of disaggregating FAF data to estimate firm level production/origination information is illustrated in Figure 7.

Figure 7: Flow Diagram FAF Disaggregation



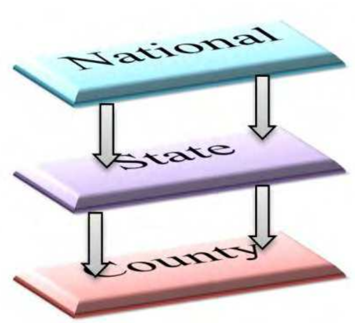
Source: Moffatt & Nichol

5.2. Identifying Production/Attraction at the County and Establishment Level

The first step in simulating the economy is to create a comprehensive map of local businesses. By so doing, a geographic framework is established in order to identify sources of production and attraction for the commodity flows within the study region. The base data comes from the County Business Patterns (CBP) released by the US Census Bureau[i]. CBP provides annual geographic and industry data for U.S. business establishments at the county and industry level.

At the county level this data is often suppressed to avoid disclosure or for not meeting publication standards. The extent of suppression decreases at higher geographic levels where the data is more aggregated. Therefore in order to estimate suppressed county level data a hierarchical approach using State and National level data is used; as identified in Figure 8. At the national level for each NAICS code, the average number of employees for each employee size bracket is calculated[ii]. At the state level, the average number of employees for each bracket size is calculated for available data; if the data is suppressed the national average is used as the estimator. By following the same logic, detailed county level data is estimated with a very good margin of error, as compared to the aggregate level of employment per county as reported in CBP[iii].

Figure 8: Top-Down Hierarchy to Estimate Suppressed County Data



Source: Moffatt & Nichol

Table 1 provides an example of the CBP employment data at the county level by NAICS. The example is for Dubuque County (061), in Iowa (19). The NAICS codes are furniture and home goods retailers.

Table 1: Example of CBP Employment Data

FIPS			Empty	Number of		Number of Establishments by Employee Size Bracket								
State	County	NAICS	Flag	Emp.	Estab.	1-4	5-9	10-19	20-49	50-99	100-249	250-499	500-999	1000+
19	061	442110		95	17	8	6	3	0	0	0	0	0	0
19	061	442210		46	7	2	4	1	0	0	0	0	0	0
19	061	442291	A	0	1	1	0	0	0	0	0	0	0	0
19	061	442299		100	5	2	0	2	0	1	0	0	0	0
19	061	443111	A	0	4	2	2	0	0	0	0	0	0	0

Source: US Census Bureau; Moffatt & Nichol

Production

Detailed firm level production by commodity is needed because firms of different sizes have different shipping behavior.

As with the previous estimation where in certain instances data was suppressed at the county level, Table 2 shows how a hierarchical approach using data from the Economic Census[iv] (EC) was used to estimate the production per employee at the county level. If the information is available at the county level, county level estimation will be used (NAICS = 444220, 445110). If the county level data is suppressed, and state level data is available, state level estimation is used (NAICS = 445120). Otherwise national level productivity estimation is used (NAICS = 445210, 445220).

Table 2: Example of Economic Census Production by Geographic Hierarchy by NAICS

NAICS6 Production per Employee ($1000s)					
State	County	NAICS	County Level Productivity	State Level Productivity	National Level Productivity
01	003	444220	225.65	235.65	217.77
01	003	445110	178.48	151.46	191.67
01	003	445120		241.75	175.79
01	003	445210			147.41
01	003	445220			179.82

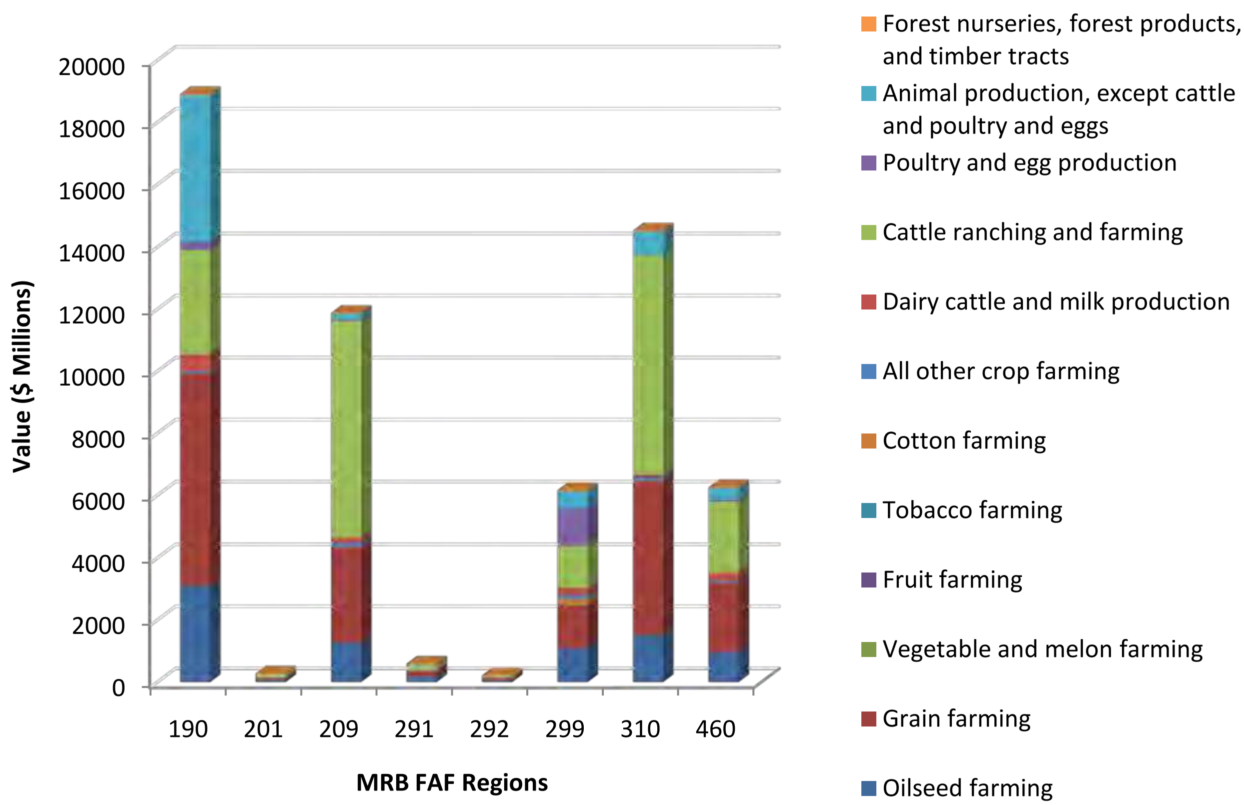
Source: US Census Bureau; Moffatt & Nichol

The total value of shipment of an individual firm is calculated by combining NAICS6-County level production per employee with NAICS6-Countly level firm size information.

It should be noted that CBP does not include information on agriculture. Therefore, Moffatt & Nichol used data provided in the Census of Agriculture, conducted by the USDA, to estimate county level production.

Figure 9 presents the production value by BEA-IO (given in descriptive title) for FAF regions within MRB.

Figure 9: Agriculture Production by BEA-IO Code



Source: US Census Bureau; Bureau of Economic Analysis; Moffatt & Nichol

Using Production Requirements to Estimate Levels of Attraction

Having established the county level production profiles described above, the next step in allocating FAF commodity flows to the county level was to determine the points of commodity attraction. These attraction locations are determined by the level of intermediate inputs consumed during production and/or the level of final goods sold. There are four basic types of attraction that occur in regular frequency:

intermediate demand via wholesaler,
intermediate demand directly sourced,
final good demand via wholesaler,
and final good via warehousing

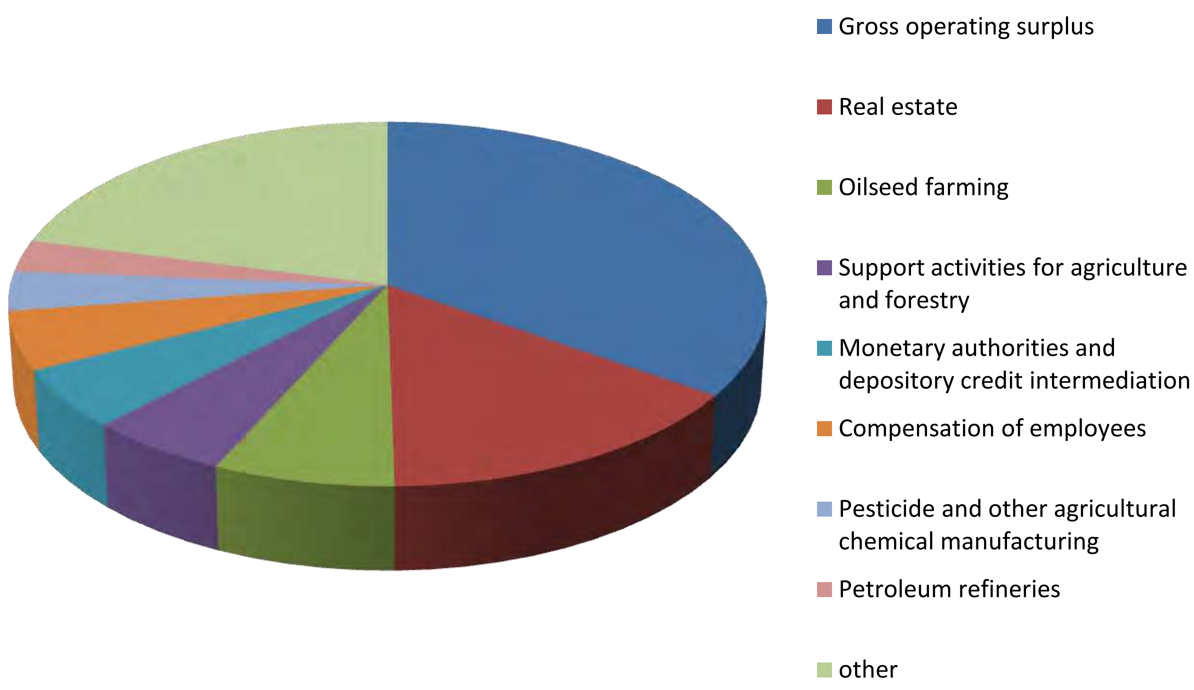
Moffatt & Nichol used the two following supply chain rules to frame the analysis. If an intermediate (e.g. a wholesaler) is used, commodity flows into the region (attraction) are modeled coming into the region to the location of the intermediate. Additionally, the movement from an intermediate to final demand is not modeled. The process used to estimate attraction for intermediate and final (retail) goods is described below.

Intermediate Demand

The 2002 Benchmark IO[v] tables are used to determine the demand for intermediate production inputs for all industries. These tables show the commodities and the value added components that an industry requires to create a unit of output. Moffatt & Nichol applied these direct requirement coefficients to the estimated firm level revenues aggregated from NAICS6 to the BEA-IO codes to estimate the input requirements per NAICS6.

As an example, Figure 10 provides the breakdown of the direct commodity requirements needed by the Oilseed Farming industry (BEA-IO 1111AO).

Figure 10: Direct Commodity Requirements for Oilseed Farming



Source: US Census Bureau; Bureau of Economic Analysis; Moffatt & Nichol

Special Case: Construction is assumed to be the value of all revenue earned by construction firms in the respective counties.

Similar intermediate input profiles, such as that presented in Figure 10, are established for each industry. The respective compositions of these profiles are later used to study how different firms satisfy their intermediate demand. The locations of intermediate input demand become the sources of attraction within the model.

Within the modeling process, several sub-rules are made to help determine likely shipment size coming into the region. These rules are applied to reflect the existing supply chain structure. These are listed below and summarized in Table 3:

1. Firms with less than 100 employees are assumed to purchase all inputs via wholesalers
2. Firms with greater than 100 employees but less than 500 are assumed to source inputs with value at or above 10% of revenues directly from a manufacturer. Inputs valued at less than 10% of revenues are assumed to be purchased via wholesaler.
3. Firms with more than 500 employees purchase all inputs with value at or greater than 5% directly from a manufacturer. Inputs less than 5% are sourced via wholesaler.

Table 3: Sub-Rules Applied to Modelling of Intermediate Attraction

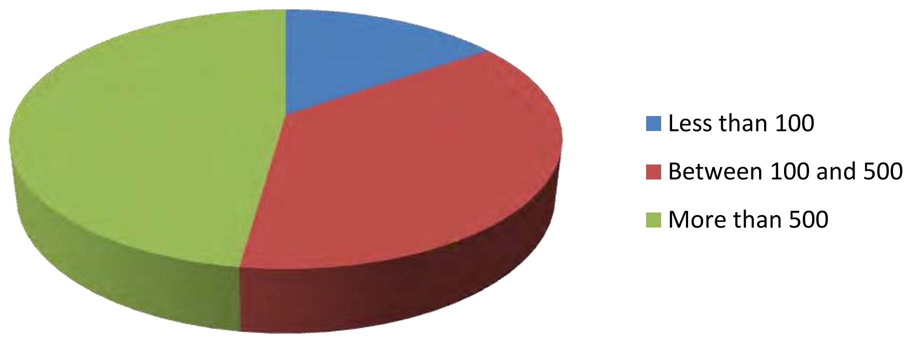
		Firms Size		
		Less than 100	**Between 100 and 500**	**More than 500**
Input Ratio	Less than 5%	Wholesaler	Wholesaler	Wholesaler
	Between 5% and 10%	Wholesaler	Wholesaler	Direct
	More than 10%	Wholesaler	Direct	Direct

Source: Moffatt & Nichol

While smaller firms with less than 100 employees may not individually generate the demand volume which would require a barge movement, the market rules identified in Table 3 dictate that their demand be handled via a wholesaler. It is this consolidation which allows for more barge-eligible demand and a realistic approach toward modeling the market.

Applying these rules to the total of firms in the MRB generates the market structure illustrated in Figure 11.

Figure 11: Total Firm Revenue by Number of Employees

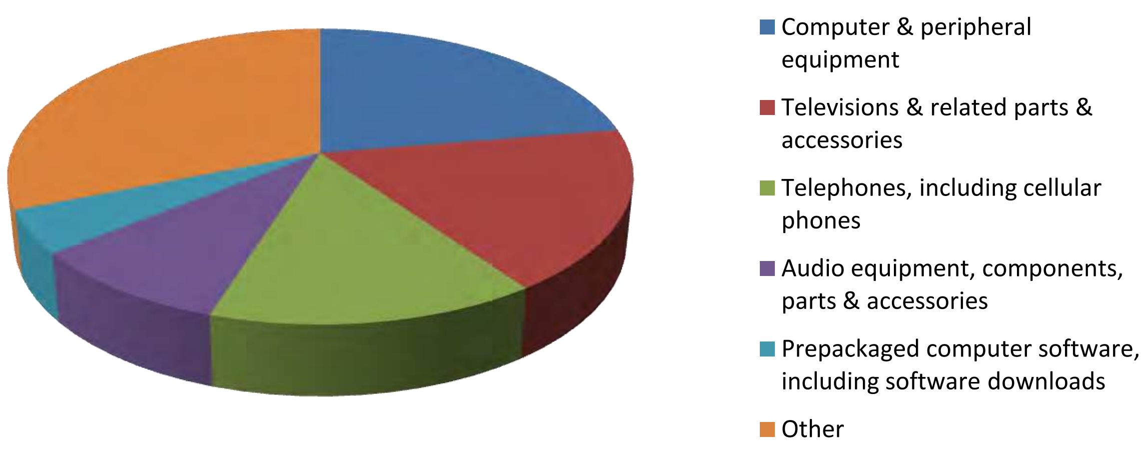


Source: US Census Bureau; Bureau of Economic Analysis; Moffatt & Nichol

Retail Demand

Retail demand is the other source of attraction to the region and is estimated on information published in Table EC07443 of the Economic Census. This table contains data on the number of establishments and their total sales[vi]. Information from table EC07443 is used to allocate demand for different product lines from the simulated economy. This is done by reducing the total estimated retail establishment revenue and calculating the demand for different product lines as a percentage of the reduced revenue of the retail establishment. Figure 12 provides an example of the composition of an electronic store's sales.

Figure 12: Percentage of Total Revenue for Radio, Television, and Other Electronics Stores (BEA-IO 443112)



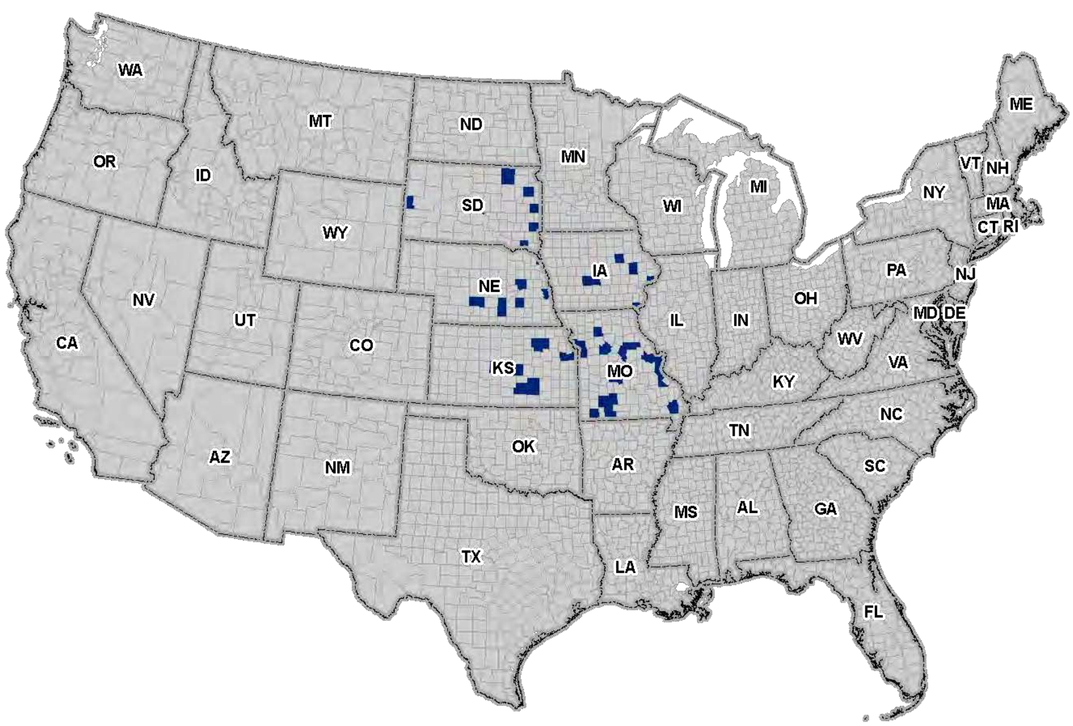
Source: US Census Bureau; Bureau of Economic Analysis; Moffatt & Nichol

As previously described for intermediate demand, it is necessary to make rules related to market structure. These rules determine the configuration of the supply chain. Retailers are classified by size based on whether they purchase goods directly from the producer or via a wholesaler.

- Retail establishments with fewer than 250 employees are assumed to purchase goods via a wholesaler.
- Retail establishments with over 250 employees source goods directly and their goods are stored at a warehouse until sorted and moved to the final retail destination.

Supply chain intermediary (warehouse/wholesaler) are assigned by a distance based model which looks for the largest retail intermediary relative to the shipment size and the distance of all suppliers. A constraint is applied requiring all intermediaries to be located within the FAF region. The locations of these intermediaries are given in Figure 13. The shipment size and county of attraction is thereby transferred from the firm to the intermediary allowing for shipment aggregation.

Figure 13: Location of Warehouses



Source: US Census Bureau; Bureau of Economic Analysis; Moffatt & Nichol

5.3.Allocation of FAF to County Level

Following the identification of sources of production and attraction, the next step was to allocate the commodity flow values reported in FAF to the county level. As a result of differing geographies (county vs. FAF region) Moffatt & Nichol used a simple distribution algorithm to assist in this process, based on the assumption that an inverse relationship exists between establishment size and distance of trade; i.e. larger firms tend to serve distant markets while small firms serve local markets. This assumption has been well established and documented in previous analysis, most recently by Holmes and Thomas (2010) who in their study conclude:

> *"Export destinations tend to be further than domestic destinations, and large plants tend to ship further distances even to domestic locations as compared to small plants."*

Additionally, referring to the work of Melitz (2003) and Stevens (2010):

> *"…that even within a narrowly defined industries, small plants tend to perform retail-like functions that are difficult to trade (e.g., custom work), compared with large plants in the same industry"... "that small plants tend to be geographically diffuse and follow the distribution of population, while large plants tend to be geographically concentrated, is consistent with the shipment distance findings reported here. As the small plants follow the distribution of population, they can meet demand by serving local customers, just like retail stores do. As the large plants may be concentrated in just a few locations, goods must be shipped to distant locations that have no source of local supply."*

Based on this assumption, Moffatt & Nichol used the algorithm to assign the largest establishments in the FAF region and BEA-IO category volumes from the furthest origination/destination .The algorithm allocates between these two until all establishments are assigned to a FAF origin/destination.

Moffatt & Nichol used the value of revenue by NAICS, as reported in the CBP, as the measure of relative production and attraction at the county level. The value of revenue was used to help explain the varying trade routes by which high and low value commodities travel designated in the FAF data. Through the decomposition of SCTG to BEA-IO codes, Moffatt & Nichol is able to reconstruct a value per ton of shipment of the SCTG codes, and assign the lower value commodities to the lower value trade routes, and vice versa. The cumulative value of revenue was controlled to the FAF total value of trade flow to ensure 100% allocation.

Table 4 offers a sample output of the allocation algorithm. It provides the domestic originations and destinations along with the company size and the value and volume for different commodity shipments. Three different types of pairings are indicted:

- **Intra-regional pairing** has an origin and destination within the MRB region;
- **Outbound pairing** has an origin in the MRB region but a destination outside the MRB region and
- **Inbound pairing** has an origin outside the MRB region but a destination within the MRB region

For computational purposes it was advantageous to pair the county-to-FAF Region for Outbound pairings and the FAF Region-to-County for Inbound pairings. All Intra-regional MRB pairs are identified on a County-to-County basis.

Table 4: Sample Output of the Allocation Algorithm

Type	Origin FIPS (County)	Domestic Origin (FAF Region)	Domestic Destination (FAF Region)	Destination FIPS (County)	Company Size	BEA-IO Code	SCTG	Mile[vii]	Value (mls)	Volume (KT)
Inbound		560	209	20173	1-4	212100	15	750	206.77	27965.34
Inbound		560	292	29071	1-4	212100	15	1115	57.61	7761.61
Inbound		560	292	29510	5-9	212100	15	1115	7.80	1050.46
Outbound	29186	299	229		100-249	212310	12	604	0.16	38.69
Outbound	29186	299	229		100-249	212310	12	604	0.11	27.48
Outbound	29091	299	471		20-49	212310	12	363	0.21	52.87
Intra-regional	20177	209	209	20177	1-4	212320	11	12	0.01	1.84
Intra-regional	20055	209	209	20093	1-4	212320	11	24	3.63	581.57
Intra-regional	20201	209	209	20027	1-4	212320	11	32	0.37	58.91

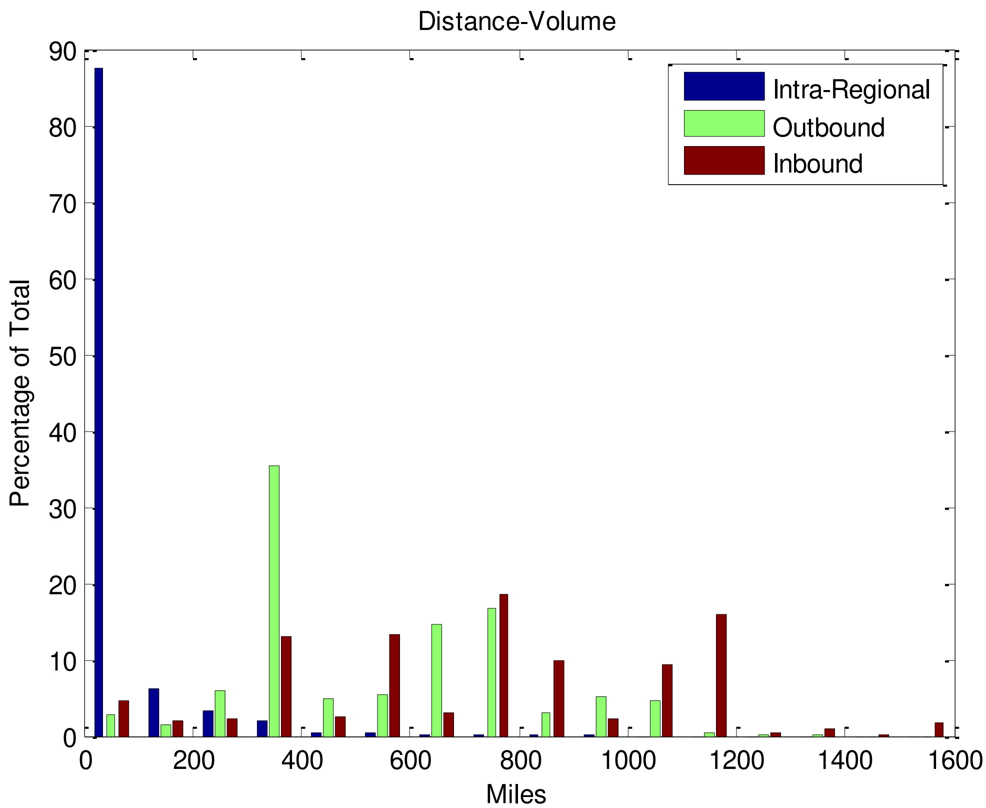
Source: Federal Highway Administration; US Census Bureau; Bureau of Economic Analysis; Moffatt & Nichol

These pairings are then used as inputs into the routing model which will estimate the least cost routes between different origin and destination parings. Each row of the table acts as an individual customer to the system. The model will measure the effectiveness of different scenarios by solving it for the least cost route of these individual customers.

It should be noted that within the sample data, of the firms which ship the same commodity (212310) from the same domestic origin (FAF 299), it is the large firm which ships the furthest distance; as designated by the allocation algorithm.

Figure 14 is the histogram of total shipment volume based on distance shipped. As illustrated, most of the Intra-regional volumes travel less than 200 miles. By comparison, the Outbound and Inbound volumes travel distances tend to be greater.

Figure 14: Histogram of Shipment by Distance by Trade Pairing

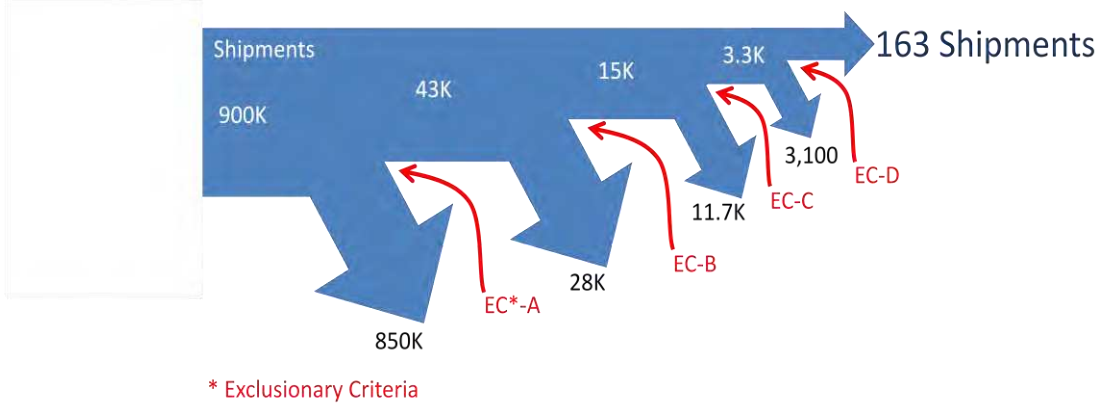


Source: Moffatt & Nichol

6. Process of Elimination

The process of elimination explains how the original data was reduced to a manageable size to be used in model without the loss of the applicability of the result.

Figure 15: Process of Elimination



Source: Moffatt & Nichol

As shown in Figure 6 MRB shipments are initially classified into two categories of shipments, those originating from MRB and those attracted to MRB. The allocation algorithm creates an extensive list of potential routing O&D pairs with approximately 90,000 routes identified as originations and 800,000 as attractions.

Figure 16 and Figure 17 highlight an import point, namely that a low number of large-volume shipments account for significantly more of the total tonnage as compared to the small share held by a high number of small-volume shipments.

The scale of the horizontal axis is scaled into “bins” which are representative of the different transportation mode types load capacities: 0-27 (truck), 28 – 104 (rail), 105 – 1,360 (barge), 1,361+ (multiple barges).

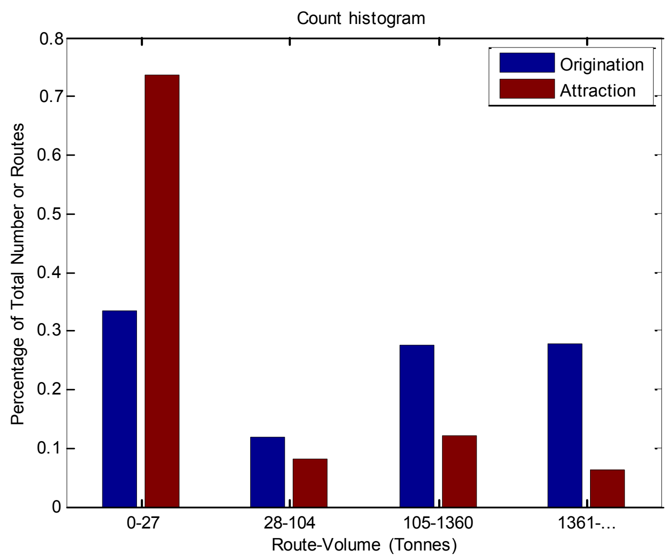
Figure 16 illustrates the number of routes based on their shipment size. The horizontal axis shows the route volume identified and the vertical axis shows the share of routings within the volume range from total number of routings. The small-volume shipments account for the most share by count.

Figure 17 illustrates the volume of the routes based on their shipment size. This shows that despite their significant share of total number of routes, low volume routes don’t have a significant contribution in the movement of commodities. Shipments of 0 to 27 tonnes account for about 30% of Origination and more than 70% of Attraction; however their share in total volumes is insignificant.

If used directly in the final route choice model, this original data set would impose a great computational burden; therefore the first exclusionary criteria (EC) were applied to the model.

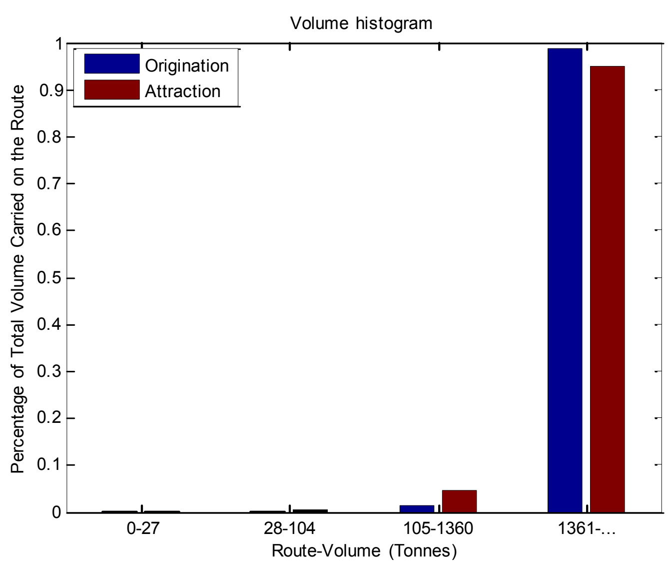
The scale of the horizontal axis is scaled into "bins" which are representative of the different transportation mode types load capacities: 0-27 (truck), 28 – 104 (rail), 105 – 1,360 (barge), 1,361+ (multiple barges).

Figure 16: Route count histogram by shipment size



Source: Moffatt & Nichol

Figure 17: Route volume histogram by shipment size



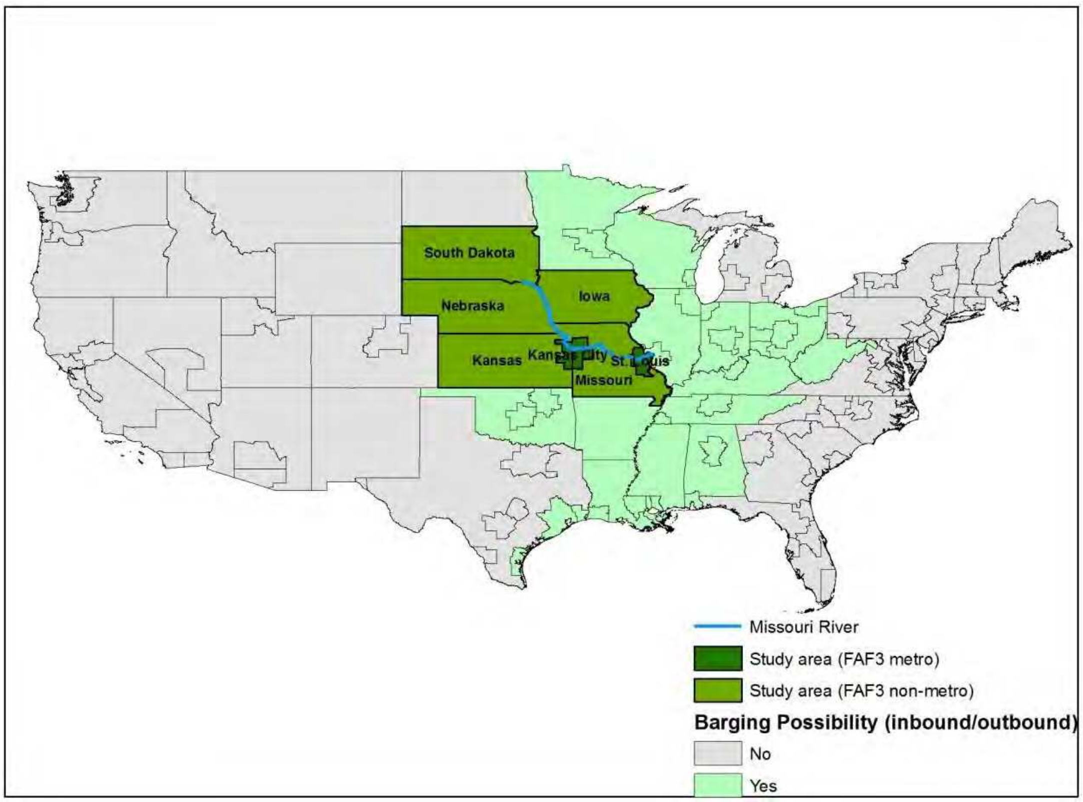
Source: Moffatt & Nichol

Elimination Criteria-A

The routing model is focused on large-volume shipments which are more likely to be routed by barge. Therefore, the first screening filtered shipments which would be too small to ship by barge as determined by a combination of the frequency at which they were shipped and the stowage factors of the commodities being modeled.

The second screening applied at this stage included the elimination of shipments to and from FAF regions which are inaccessible via barge. Figure 18 shows a map of the FAF regions considered accessible and those that were not.

Figure 18: Map of Accessible FAF Regions

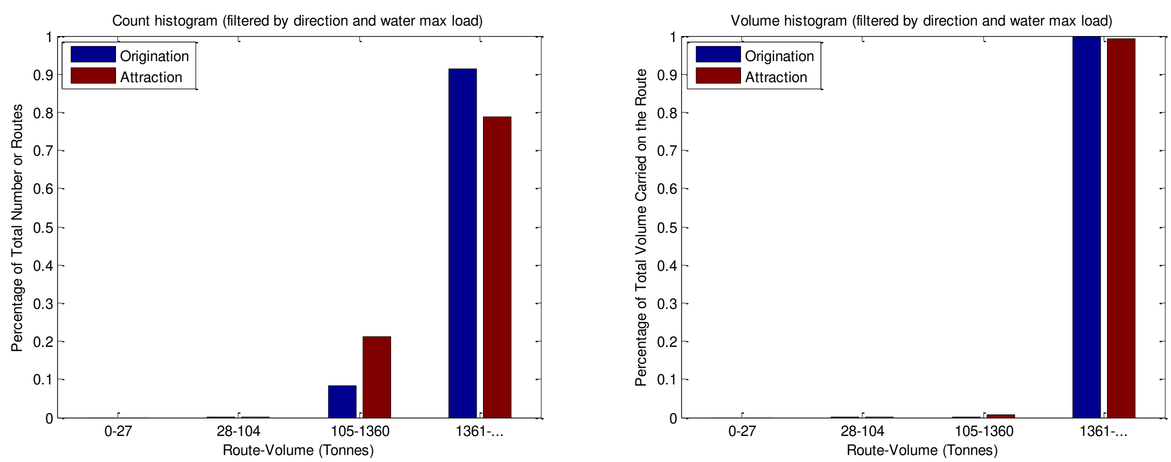


Source: Moffatt & Nichol

By applying these two filters, the total number of routings would decrease to about 13,000 from the initial 90,000 for origination, and to 30,000 from the initial 800,000 for attractions. This significant reduction in the number of routings is accomplished without compromising the applicability of the outcome as shown in Figure 19.

The chart on the left shows that by count, the total number of routes has been isolated to the larger shipments, while the smaller shipments have been eliminated altogether. However, in terms of tonnage, the vast majority of the volume has remained in the largest shipments as shown in the chart on the right, signaling that the structure of the original data set has been maintained throughout this first elimination.

Figure 19: Count and Volume of Second Data Set



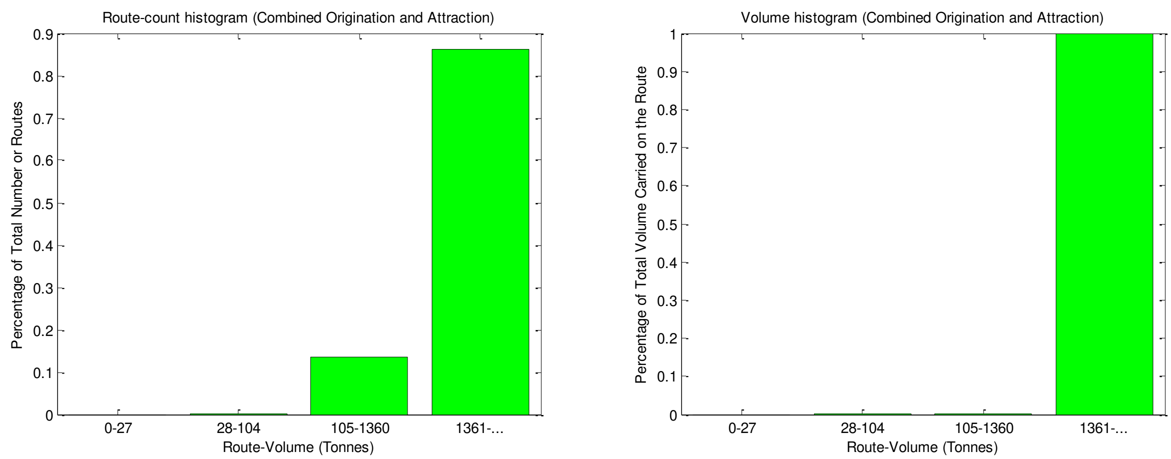
Source: Moffatt & Nichol

<u>Elimination Criteria-B</u>

The next layer of screening took the filtered origination and attraction tables and combined them together to remove the double counting of routes which originate in and are destined to locations in MRB. These became the Intra-regional shipments.

Additionally, the warehousing and wholesaling rules explained in section 5.2 were applied to consolidate small shipments into larger ones. The resulting third data set had 14,763 routings with the following composition for route counts and volume:

Figure 20: Count and Volume of Third Data Set



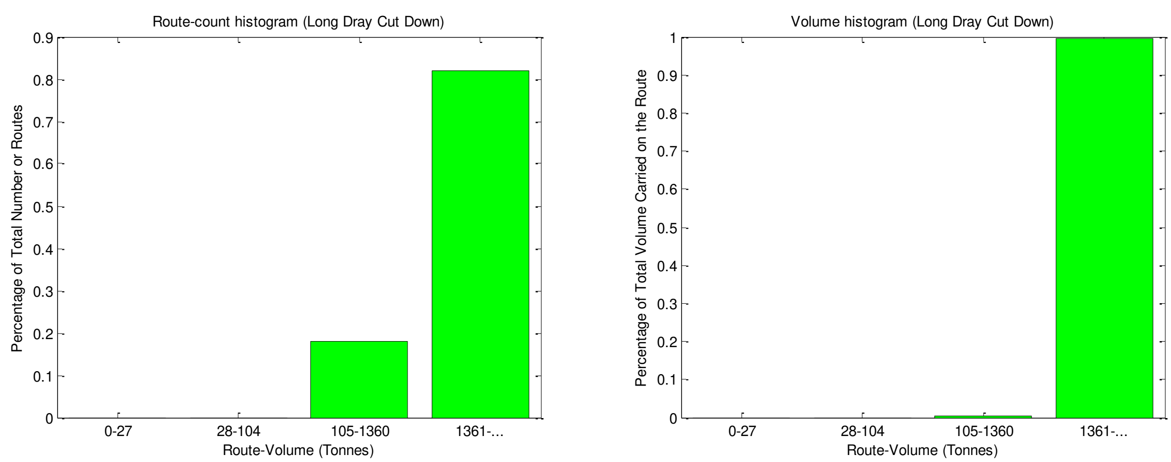
Source: Moffatt & Nichol

Elimination Criteria-C

The next step of screening was the elimination of O&D pairings for which total port drayage distances were greater than 40% of the direct trucking distance. These pairs were eliminated so that drayage associated with a barge move would not be adversely increased by long drayage from counties in the far corners of the study area routed to the Missouri River.

The resulting data set had 3,382 routings with the following composition for route counts and volume:

Figure 21: Count and Volume of Fourth Data Set



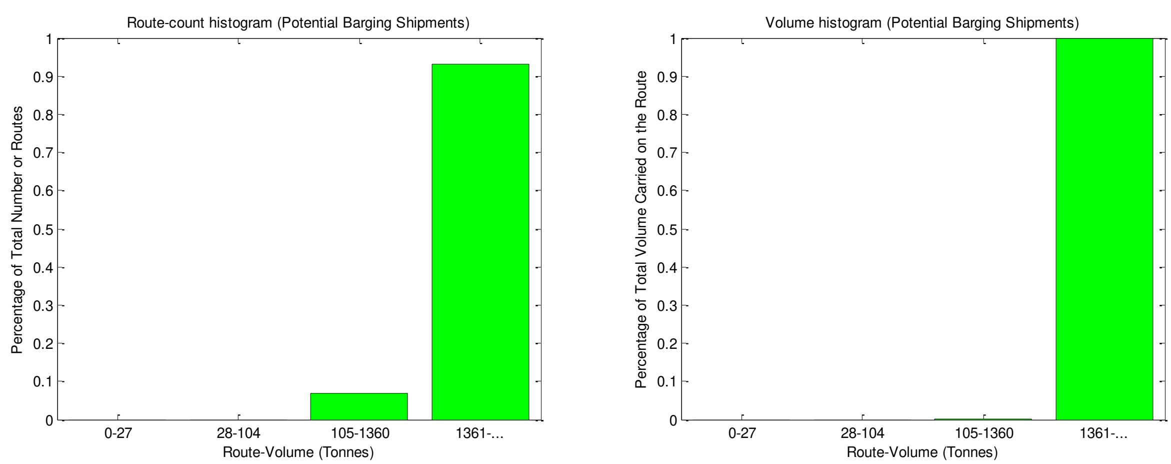
Source: Moffatt & Nichol

Elimination Criteria-D

The final screening eliminated the inventory costs associated with foreign bound exports and intra-regional moves. The decision to remove the inventory costs from the exports was founded on the assumption that US exporters tend to choose logistic routes to maritime ports based on the lowest transportation cost route. Inventory costs were removed from the Intra-regional movements because given the relatively short times and distances of the routes, inventory carrying costs are not considered to be a significant constraint. Additionally, drayage and handling costs (as well as the time involved) to get a barge shipment to a water port and on to a barge (or to get the shipment off of the barge and to its final location) were eliminated for the origin or destination if its county has a water port in it, or if the origin or destination is outside of the MRB.

The 163 shipments for which barge was calculated as the cheapest route of transportation are the potential barging routes. Of these 163 routings, 121 of them are estimated to go on the Missouri River. The reason for the cut-down from 163 to 121 is that an assumption was made that shipments involving four counties near the Mississippi River that were said to go on barge would go on the Mississippi River rather than the Missouri River. The resulting table has 163 routings with the following composition for route counts and volume:

Figure 22: Count and Volume of Final Data Set



Source: Moffatt & Nichol

7. Mode Choice Simulation

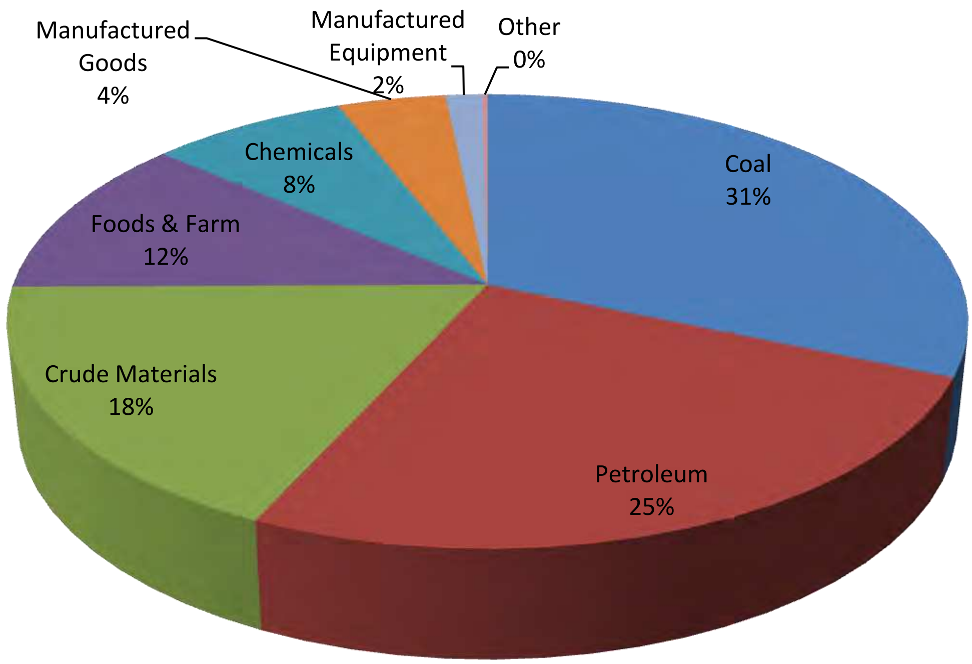
Barged Commodities and Their Relation to Logistics Costs

Two overriding characteristics, namely large volume and low value, generally allow for a given commodity to be shipped by barge, as evidenced by the current mix of commodities illustrated in Figure 23.

In 2008 approximately 589 million tons of cargo was transported on the US's intercoastal waterways, of which coal was the largest volume accounting for 31% of the total, followed by petroleum (25%) and crude materials including gravel and sand (18%). Agriculture products, primarily grains and soybeans, chemicals and manufactured goods also account for a significant share of the total weight.

These goods are typically shipped in very large quantities in order to capture the lower transportation costs associated with economies-of-scale. Given the large shipment size and the slower form of transportation, the inventory carrying costs associated with these bulk commodities are generally lower by comparison to that of other high value commodities, particularly consumer related goods.

Figure 23: 2008 Intercoastal Waterway Volumes by Commodity Share



Source: US Army Corps of Engineers Waterborne Commerce Data

Barge Capacity Relative to Truck and Rail

As compared to truck or rail, barge transport exhibits strong economies of scale. Shipping large volumes in bulk reduces the fixed cost per unit of commodity.

In part this is due to the load carrying capacity of a barge, which is much greater than that of either truck and/or rail. In order to utilize this capacity efficiently, thus lowering the average cost of transportation per ton, significant volumes of material must be available to fill the barge.

The average capacity of a river barge is approximately 1,500 tons, as compared to the average 25 tons per truck and 100 tons per rail car; suggesting that every barge load can carry the equivalent of 60 trucks or 15 rail cars. The comparison is more dramatic once the average size of a barge tow is considered.

Barge tows typically consist of 15 barges (5 long × 3 abreast) on sections of the Mississippi River with locks, and can increase to 30 or 40 barges on sections where there are no locks. If the same equivalent described above is applied to the smaller tow size, this suggests that 900 truck loads and/or 225 rail car loads can be accommodated by a single 15-barge tow.

Time in Transit and the Associated Inventory Carrying Cost

Barges are a slower form of transportation relative to either truck or rail, typically averaging between 3.5 and 11 miles per hour (mph). This means that goods carried by barge will typically spend more time in transit compared to those carried by other modes over similar distances.

For example, in order to make trip between St. Louis, MO and New Orleans, LA, the shortest route by truck is 678 miles. If the truck were able to maintain an average speed of 60mph this would equate to total trip time of 11 hours, as detailed in Table 5. Similarly the 697 mile trip by train is estimated to take approximately 23 hours, and the trip by barge, nearly 350 miles and 120 hours (5 24hr-days) longer.

Table 5: Shortest Trip Distance by Mode between St. Louis and New Orleans

	Miles	mph	Trip hrs
Truck	678	60	11
Rail	697	30	23
Barge	1,048	7	150

Source: Moffatt & Nichol

The longer goods spend in transit, the more they accrue inventory carrying costs (ICC), which can dramatically alter the routing decisions of shippers seeking to keep their logistics costs as low as possible. In order to mitigate the potential threat of higher ICC resulting from longer periods in transit, the type of good being shipped generally has to be readily accessible, thus reducing the threat of stock-out, and have long “shelf lives,” meaning low depreciative values.

Therefore, the most common commodities which meet these criteria are typically the large volumes of bulk goods, including mined/quarried material and agriculture products.

Additionally, many of the end users of the bulk materials shipped by barge, including utilities, are located on or have receiving facilities in close proximity to the inland waterway.

Proximity: In the Context of Container & Break Bulk Cargos

The use of barge for moving containerized commodities generally remains limited to inter-port redistribution services, such as that linking the Ports of Baltimore, Philadelphia, and NY/NJ, and the RO/RO barge services between mainland US ports and the Caribbean Islands and Alaska. Factors that limit the use of barges to carry containers include:

- Slow speed of barge impacting inventory costs
- High load on/load off terminal handling costs
- The extended time required to accumulate a barge load of containers, particularly as compared to trucks

Furthermore, the inland infrastructure which has supported the rapid growth of container trade in the US, namely an international and regional network of inland ports, intermodal yards, and distribution centers strategically located near or adjacent to primary connecting road and rail networks is not geared toward the inland waterway structure.

7.1.Routing Simulation Inputs

In order to calculate the least cost route/mode of shipping, many different parameters have to be estimated. These parameters can either be associated with costs or with time (which is then converted in to inventory carrying cost). They can also be broken down as relating to either "links" or "nodes". Links are defined as surface pathways over which goods are transported (roads, rails, or waterways) while nodes are connecting points (terminals) where goods are lifted off or on, stored, or manipulated.

Link Costs

Truck: Two different trucking rates were used, one for drayage (determined to be trucking of 100 miles and under, and one for long-haul (determined to be trucking over 100 miles). Both rates were obtained from a small sample survey of Midwestern trucking companies. The drayage rate is on a per hour basis while the long-haul rate is only a per mile basis which takes in to account fixed and variable costs within it.

Rail: The data used for rail was the 2007 data from the STB Rail Rate Study. The short, medium, and long scenarios were analyzed so that these different distance categories could be applied to the different distances of the rail shipments. The revenue was divided by the car miles to get a revenue/car/mile measure. When possible, the data was viewed for railroad-owned cars only, but that distinction was usually not offered. In addition, data for single-car lots (5 and fewer cars) was preferred, but this distinction was only offered for one commodity. The different cargo categories used in the sample data were then converted to fit the commodity categories used by M&N.

Barge: The barge cost was calculated by averaging previous grain barge rates. Two sets of Mississippi River grain barge rates were used: from Minneapolis-St. Paul to New Orleans, and from St. Louis to New Orleans. The average weekly river barge rates (which were expressed in quarters) between 2000 and 2010 were averaged for each route (with the exception of a few quarters for which rates weren't posted). These averages were then used to find a per ton mile rate for each route. These two per ton mile rates were then averaged to make one overall rate. This rate was then multiplied by 1500 to estimate the per mile cost of a standard river barge filled to capacity. This was then the barge rate used for all commodities, whether or not that commodity could even fit 1500 tons on a barge.

Loading & Unloading Inputs

Along with the transportation costs on the connecting segments of road, rail and waterway, Moffatt & Nichol has also applied costs to the nodal points of switching.

Moffatt & Nichol classified the commodity groupings into four commodity handling types which are assumed to share similar loading and unloading attributes, and thus use similar equipment. Commodities were designated into the respective handling types based on the current method by which the majority of volumes are handled.

These handling types are:

- Containers
- Dry Bulk
- Liquid Bulk
- Break Bulk & Neo Bulk & Project Cargo

For the movement of container volumes, costs were applied to points of loading and unloading. Costs were produced for lifts on/off truck, rail and barge. The value of these costs was established using estimates of handling charges.

The following commodities were modeled in containers:

Table 6: SCTG Codes Classified as Containerized

Containers (SCTG Code & Description)			
04	Animal Feed And Products Of Animal Origin, n.e.c.	28	Paper Or Paperboard Articles
05	Meat, Fish, Seafood, And Their Preparations	29	Printed Products
06	Milled Grain Products And Preparations, Bakery Prods.	30	Textiles, Leather, And Articles
07	Other Prepared Food Stuffs And Fats And Oils	31	Nonmetallic Mineral Products
08	Alcoholic Beverages	35	Electronic And Electrical Equip. And Components
09	Tobacco Products	38	Precision Instruments And Apparatus
21	Pharmaceutical Products	39	Furniture And Furnishings
23	Chemical Products And Preparations N.E.C.	40	Miscellaneous Manufactured Products
24	Plastics And Rubber		
27	Pulp, Newsprint, Paper, And Paperboard		

Costs for dry bulk commodities were produced using a rate charged for loading/unloading bushels of soybeans as a base. The modeled estimate is $0.05/bushel or $1.75/ ton for all grains using an average bushel/ton. Inorganic commodities, such as fertilizers (phosphates) and other mined commodities including metallic ores and nonmetallic minerals were assumed to have higher loading costs, but are nevertheless comparable given the use of similar equipment.

The following commodities were designated as dry bulk goods.

Table 7: SCTG Codes Classified as Dry Bulk

Dry Bulk (SCTG Code & Description)			
02	Cereal Grains	14	Metallic Ores And Concentrates
03	Other Agricultural Products	15	Coal
11	Natural Sands	20	Basic Chemicals
12	Gravel And Crushed Stone	22	Fertilizers
13	Nonmetallic Minerals n.e.c.	41	Waste And Scrap

Liquid bulk commodity costs were developed for truck, rail and barge, and represent the singular cost of the "hook up" for respective transportation modes to the storage tank. Those commodities classified as liquid bulk are:

Table 8: SCTG Codes Classified as Liquid Bulk

Liquid Bulk (SCTG Code & Description)			
16	Crude Petroleum	18	Fuel Oils
17	Gasoline And Aviation Turbine Fuel	19	Coal And Petroleum Products, n.e.c.

Given the variation in the commodities classified as break bulk, neo bulk and project cargo, the costs of loading/unloading has been modeled either on a per ton or per load basis. Forest Products, Wood Products, Iron and Steel, were modeled by the load. For the remaining commodities a loading/unloading cost per ton is applied.

Table 9: SCTG Codes Classified as Neo Bulk & Project Cargo

Break & Neo Bulk & Project Cargo (SCTG Code & Description)			
10	Monumental Or Building Stone	33	Articles Of Base Metal
25	Logs And Other Wood In The Rough	34	Machinery
26	Wood Products	37	Transportation Equipment n.e.c.
32	Base Metal In Primary Forms And Basic Shapes		

Inventory Carrying Cost

To measure the estimated inventory carrying cost, M&N used the inventory carrying cost percentages from US Department of Transportation (USDOT) Federal Railroad Administration's *Intermodal Transportation and Inventory Cost Model* (ITIC-IM), as can be seen in Table 10. These percentages were multiplied by the value of the shipment and by the days the shipment was in transit in order to get the inventory carrying cost for a shipment.

Table 10: Inventory Carrying Cost by Commodity (STCC Code)

Two-digit STCC	Description	Service Percent	Inventory Carrying Cost Percentage
01	Farm products	95%	20%
08	Forest products	95%	20%
09	Fish	98%	20%
10	Metallic ores	90%	20%
11	Coal	90%	20%
13	Crude petroleum or natural gas	95%	30%
14	Non-metallic minerals	90%	20%
19	Ordnance or accessories	95%	35%
20	Food & kindred products	97%	30%
21	Tobacco products	95%	30%
22	Textile mill products	95%	20%
23	Apparel & other textile mill products	95%	30%
24	Lumber & wood products	90%	25%
25	Furniture & fixtures	95%	30%
26	Pulp, paper & allied products	90%	25%
27	Printing & publishing	95%	30%
28	Chemical & allied products	95%	25%
29	Petroleum & coal products	95%	20%
30	Rubber & misc. plastic products	95%	25%
31	Leather & leather products	95%	30%
32	Stone, clay & glass	90%	20%
33	Primary metal industries	90%	20%
34	Fabricated metal products	95%	30%
35	Industrial machinery & equipment	95%	30%
36	Electronic & other electrical equipment	95%	30%
37	Transportation equipment	95%	25%
38	Instruments & related products	95%	35%
39	Misc. mfg industries	95%	25%
40	Waste & scrap	90%	15%
41	Misc. freight shipments	95%	25%
42	Empty containers, shipping devices	90%	15%
43	Mail, express traffic	95%	30%
44	Freight forwarder traffic	95%	30%
45	Shipper assoc. or similar traffic	98%	30%
46	Misc. mixed shipments	95%	30%
47	Small package freight	95%	30%
48	Unknown Commodity	95%	30%
49	Hazardous materials	95%	25%
50	In bulk in boxcars	95%	25%
99	Mixed shipments	95%	25%

Source: US Department of Transportation; Federal Railroad Administration

8. Application of Costs

For trucking, a distinction is made between drayage (less than 100 miles) and long-haul (more than 100 miles). If a shipment goes by only truck, the trucking transportation costs are estimated on simply point-to-point without inclusion of any handling charges. This also means that the inventory cost of trucking is based only upon the time the truck is in transit.

The model also makes series of assumptions with respect to costs associated to rail. The rail cost is calculated excluding loading/unloading and drayage costs. Most of the commodities moved by rail are bulk, and it is assumed that the facilities acting as origins and destinations are located on a rail siding. This assumption makes drays unnecessary and loading/unloading the responsibility of the shipper/receiver. This means that the inventory cost for rail is based solely upon the time the rail is in transit.

Unlike what was assumed for rail and truck, the use of barge sometimes involves a third party facility and a change in mode of transportation. Therefore, in some scenarios, drayage (to get the shipment to or from a water port) and handling (to unload the trucks and load the barges or vice versa) were included in addition to the cost of barge transportation. However, drayage and handling fees and wait times were not included for an origin or destination if it was in a county that had a water port, or if the origin or destination was located outside of the MRB. The dray/handling wasn't included for an origin or destination if it was in a country with a water port because, in these scenarios it was assumed that the facility would be on the water and therefore wouldn't need to truck the shipment to and from the water and could load the barge at their convenience. The dray/handling wasn't included for an origin or destination outside of the MRB because it was also assumed that these facilities would be on the water, making a dray unnecessary and the loading or unloading the responsibility of that party. In the situations where a dray and handling were incorporated, the total cost of the barge trip would include the cost of the actual barge transportation, the trucking costs needed for drayage, the handling costs, as well as the inventory cost involved for the time of the trip (which would include the time of barging, the time of any trucking, and the wait times involved with any handling).

In addition, there were certain scenarios in which inventory cost was not included as part of the cost of the shipment. Inventory cost was not included for Intra-regional shipments or for Outbound shipments that were destined to be exports. This means that for these shipments, there was no inventory cost taken in to account for rail, truck, or barge. The decision to remove the inventory costs from the exports was founded on the assumption that in many cases the products are shipped FOB, and for most commodities that have high barge potential, have high dwell times throughout the export process. Inventory costs were removed from the Intra-regional movements because given the relatively short times and distances of the routes, inventory carrying costs are not considered to be a significant constraint.

9. Conclusions

Table 11 demonstrates how the additional costs and wait times associated with barging in the model can impact the affordability of transporting goods via barge verses other modes. This table analyzes the 3,382 barge eligible O&D pairings (which is the data before elimination criteria D was enforced). The left half of the table provides the transportation costs (defined here as all costs except inventory cost) and the inventory costs associated with the different modes of transportation considering only the costs incurred during the time spent on that mode (on only rail, barge, or truck). These costs are expressed as a percentage of shipment value. The right half of the table demonstrates the impact of adding drayage and handling costs to the barge transportation cost as well as adding in the time of draying and the wait times involved with switching modes for barge to the inventory costs for barge (Note: the drayage and handling costs and wait times were added to all barge movements, even if some of these fees and times were later excluded from certain shipments for analysis purposes).

Table 11: Cost Comparison Between Modes

	Excludes Dray and Handling		Includes Dray and Handling	
	Transport Costs as a percent of Shipment Value	Inventory Carrying Costs as a percent of Shipment Value	Transport Costs as a percent of Shipment Value	Inventory Carrying Costs as a percent of Shipment Value
Barge	3.8%	133.3%	9.5%	215.6%
Rail	4.7%	13.7%	4.7%	13.7%
Truck	13.5%	18.6%	13.5%	18.6%

Source: Moffatt & Nichol

The left hand side of the table shows that when the shipments don't include dray/handling, barge transportation costs equate to 3.8% of the value of the shipment. This makes barge the cheapest form of transportation for shipments.

However, when including dray/handling, the total transportation costs of the intermodal barge movement jumps to 9.5% of the value of the shipment. At this level barge is no longer the cheapest mode of transportation. Thus the added cost of the dray/handling makes the barge alternative not as attractive for shipments.

Barge becomes the most expensive form of transportation when the inventory carrying costs are applied. As a result this limits the types of goods which can potentially be barged to low value commodities, which can dwell for extensive periods without incurring high inventory costs.

Given the information presented in Table 11 showing the impact of inventory costs on barge shipments, it is not surprising that Outbound shipments represent the majority of potential volumes (

Figure 24) in that, as explained above in the screening criteria, inventory costs were removed from exports as well as Intra-regional shipments.

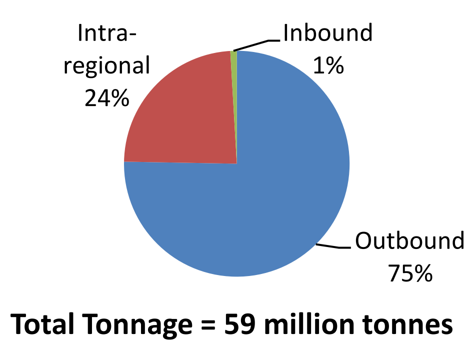
Total Potential

Moffatt & Nichol estimates that approximately 59 million total tonnes of annual commodity shipments could potentially move by barge on the Missouri River as noted in

Figure 24. By shipment type, 75% of this potential is accounted for by Outbound shipments. Intra-regional shipments represent nearly all of the remaining tonnage. In part, the dominance of these two shipment types can be explained by the model criteria which excluded inventory costs associated with foreign bound exports and Intra-regional movements.

Inventory carrying costs can be a burdensome expense when barging, particularly if there are additional drays and wait times involved. It is therefore not surprising that so many of the potential Missouri River barge shipments do not meet the criteria for inventory carrying cost.

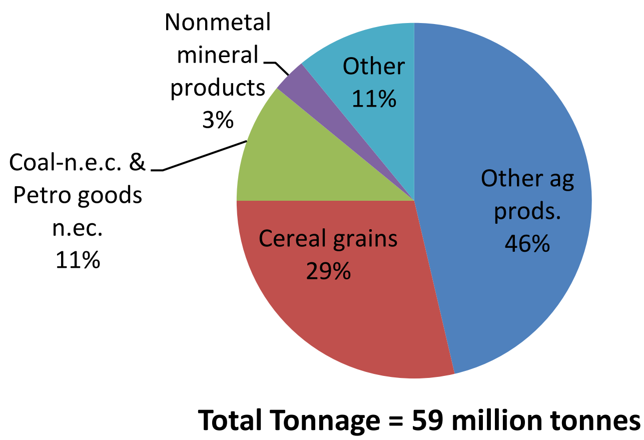
Figure 24: Potential Missouri River Barge Volume by Shipment Type



Source: Moffatt & Nichol

By commodity, it can be seen that cereal grains and other agricultural products account for roughly 75% of the total potential. It is not surprising that these two commodity groups represent such a large share given that there is a substantial volume of production in counties adjacent to the River. Furthermore, shipments are typically in large tonnages, an attribute which favors barge. The identified shipments of these two commodity groups are either exports or intra-regional movements, meaning that they did not have an inventory carrying cost levied against them, which helped make the overall price of moving the shipment lower.

Figure 25: Potential Missouri River Barge Volume by Commodity

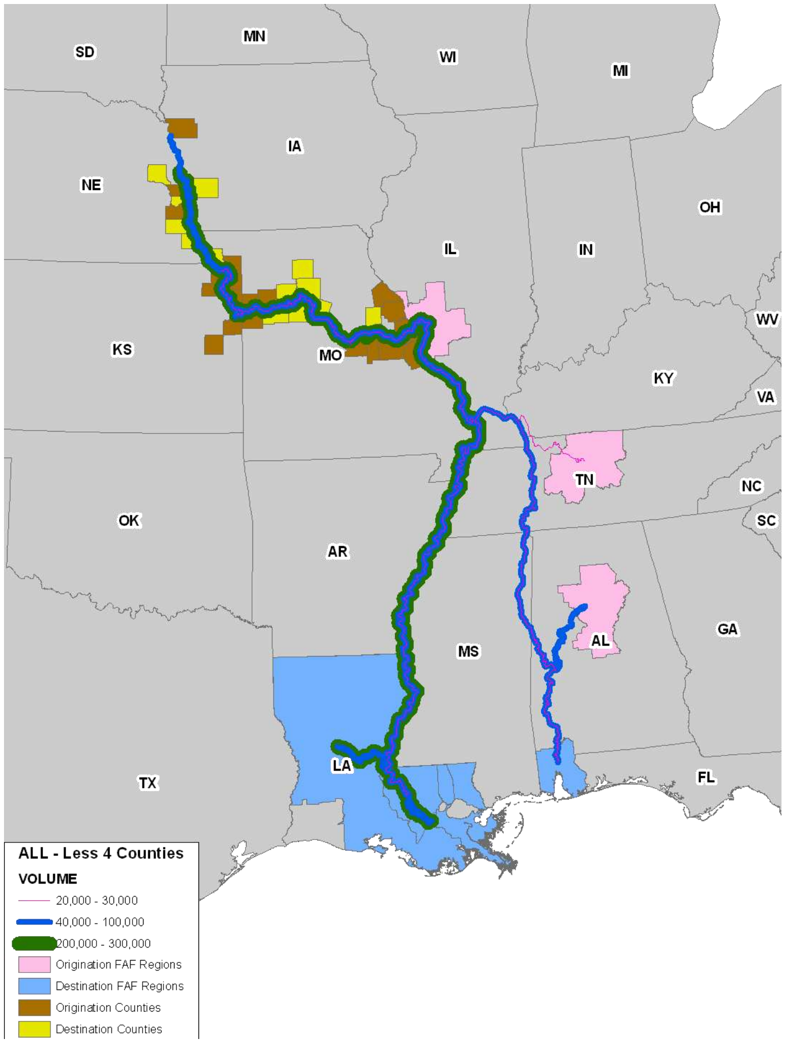


Source: Moffatt & Nichol

Figure 26 illustrates the commodity flows of the potential shipments for all three shipment types and all identified commodities. The map shows the counties/FAF regions of origin and counties/FAF regions of destination. Several notable observations can be made:

- Within MRB, the majority of origin and destination counties are located adjacent to the Missouri River.
- Outbound shipments are destined to southern port regions, (denoted in blue) including New Orleans and Mobile Alabama, and are likely foreign exports. These shipments represent the heaviest flow.
- Inbound shipments originate from three regions in Alabama, Tennessee and Illinois respectively. These are primarily shipments of coal and gravel.

Figure 26: Potential Commodity Flow Routes



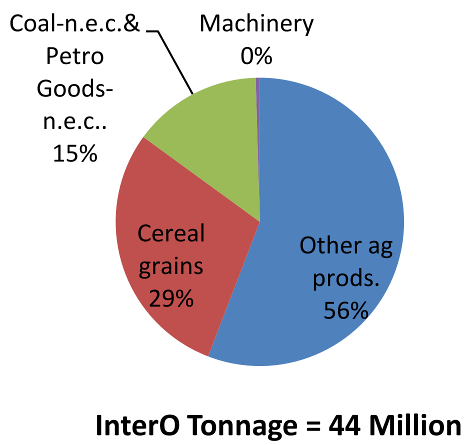
Source: Moffatt & Nichol

The commodity and routes of the three shipment types are addressed and discussed in greater detail in Figure 27 through Figure 32.

Outbound Potential

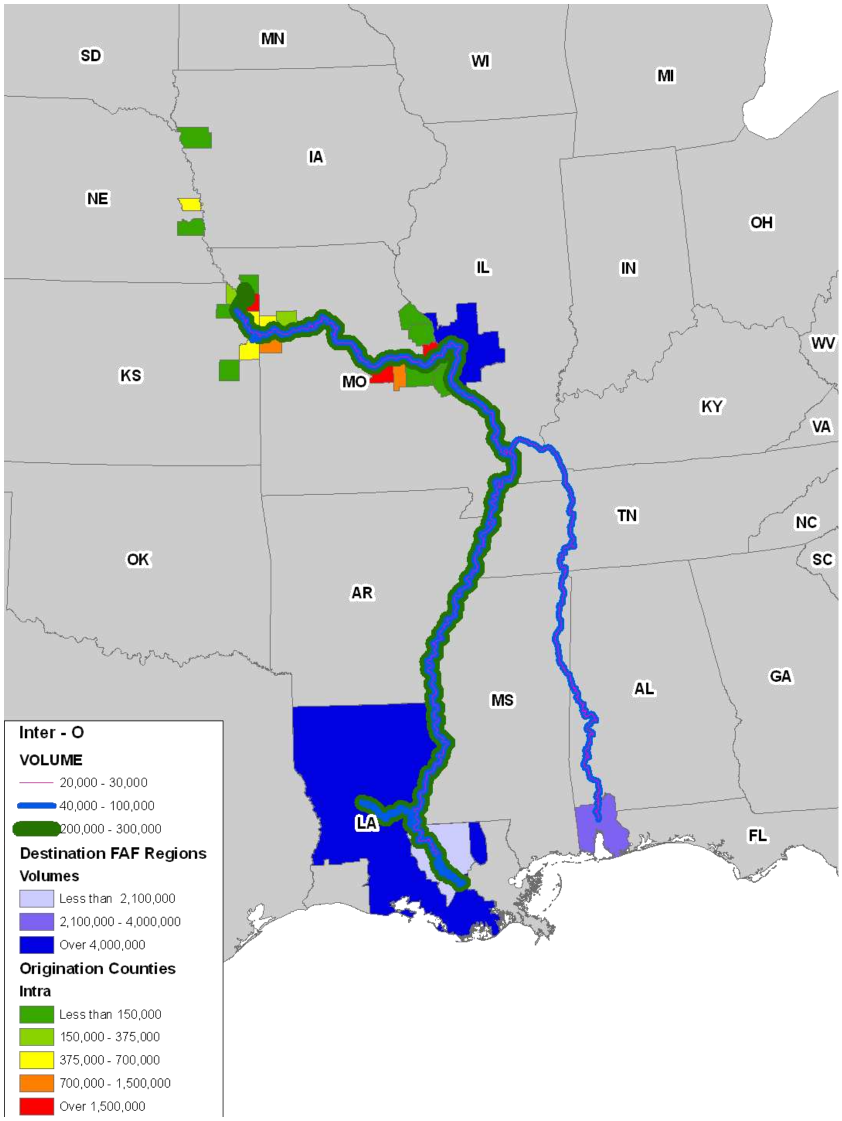
Given that Outbound shipments made up the majority of the potential Missouri River barge volumes, it should not be surprising that the commodity composition of the Outbound shipments is similar to the overall commodity make-up. Other agricultural products, cereal grains, and coal and petroleum products n.e.c. account for almost all of the tonnage. The routes of these shipments can be seen in Figure 28, and again it becomes evident that the majority of these head south for eventual exportation. The counties from which these shipments originate tend to be on or close to the Missouri River, further enforcing the importance of no or little dray in order to keep a barge movement competitive.

Figure 27: Commodity Composition of Potential Outbound Shipments



Source: Moffatt & Nichol

Figure 28: Potential Outbound Commodity Flow Routes

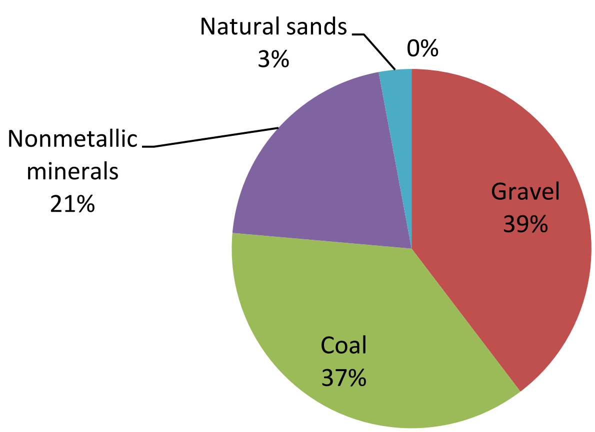


Source: Moffatt & Nichol

Inbound Potential

Inbound shipments make up a very small portion (approximately 1%) of the potential Missouri River barge movements. This volume is made up of dry bulk materials such as gravel, coal, and nonmetallic minerals. As can be seen in figure 30, the potential volumes originate in areas in Alabama, Tennessee, and Illinois, while the destinations are along or near the river throughout the MRB.

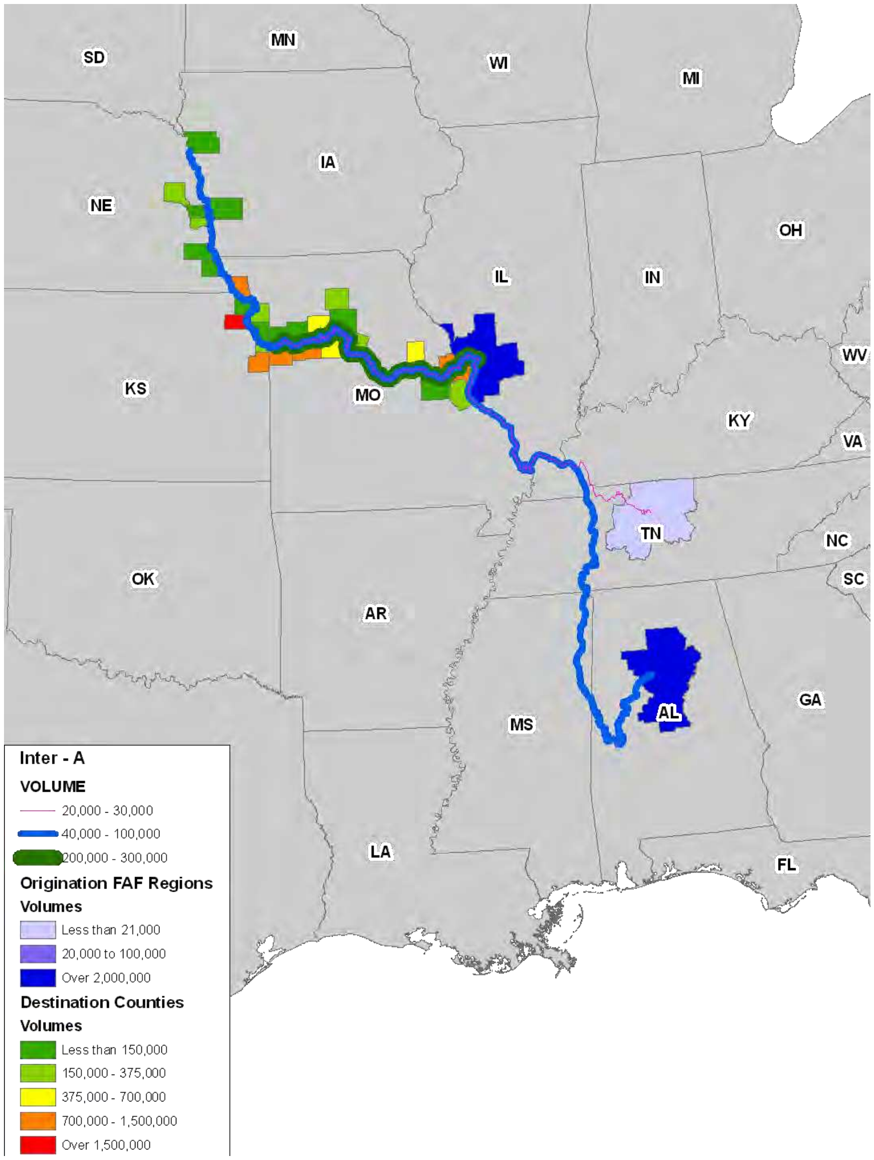
Figure 29: Commodity Composition of Potential Inbound Shipments



Inbound Tonnage = 500,000 tonnes

Source: Moffatt & Nichol

Figure 30: Potential Inbound Commodity Flow Routes

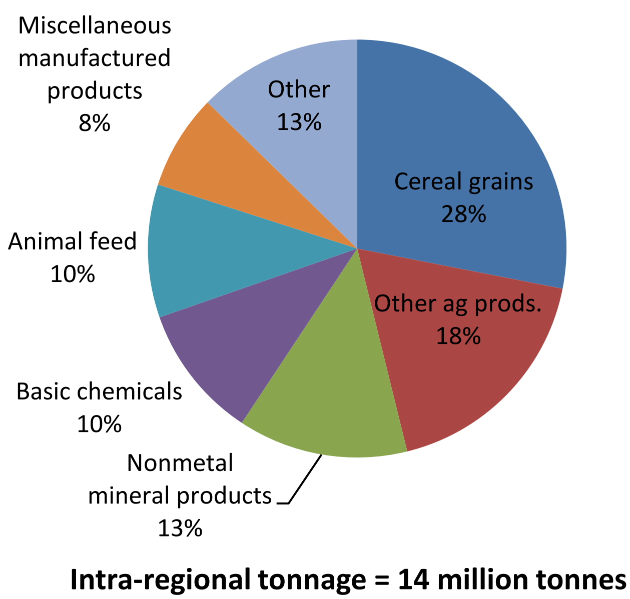


Source: Moffatt & Nichol

Intra-regional Potential

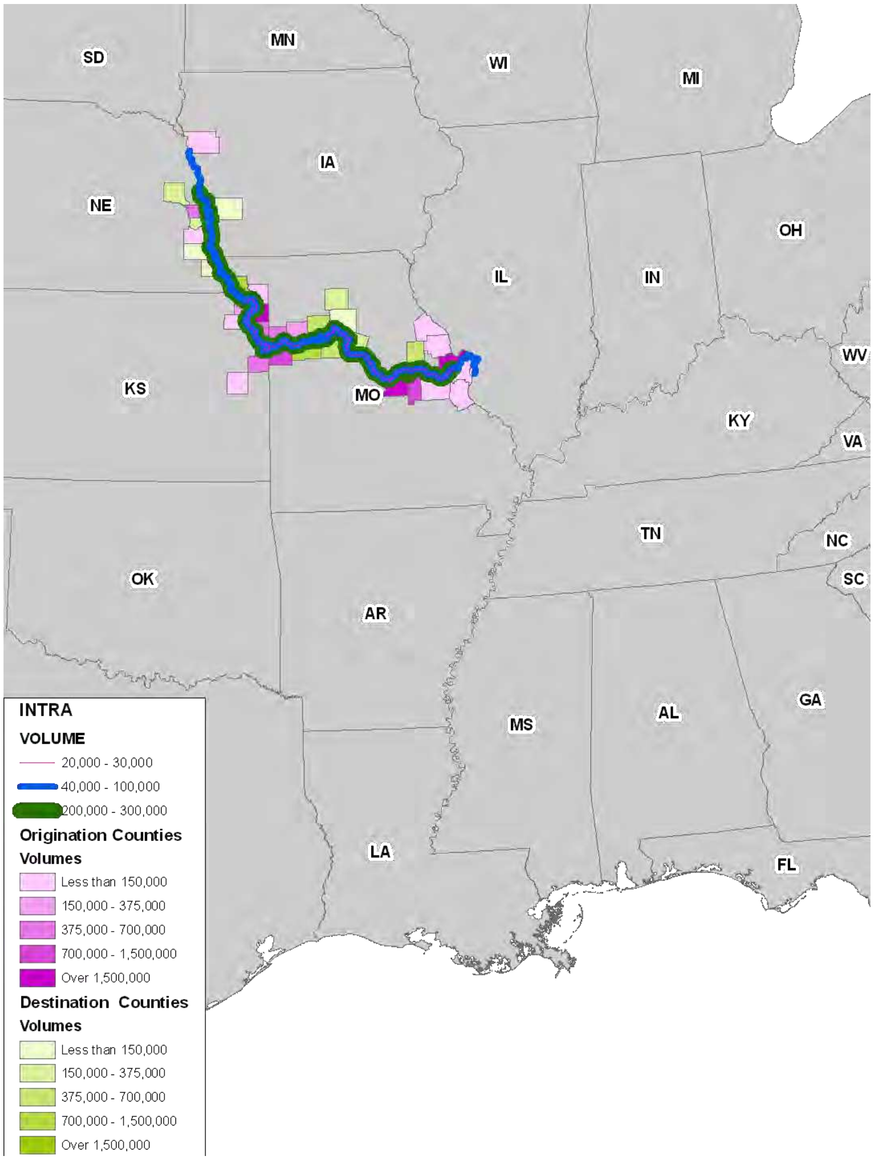
The composition of volumes by commodity for potential Intra-regional shipments on the Missouri River has a wider make-up than that of the Inbound or Outbound potential volumes, suggesting that there are more industry types which barge can serve within this smaller geography. As illustrated in **Figure 32** the vast majority of the O&D counties lie directly on the River or in very close proximity. There appears to be a clustering of high activity near the urbanized areas of St. Louis, Kansas City, and Omaha, which suggests that barge service could be used for varying types of industries within these clusters. This helps to explain the comparatively greater variety of commodities.

Figure 31: Commodity Composition of Potential Intra-regional Shipments



Source: Moffatt & Nichol

Figure 32: Potential Intra-regional Commodity Flow Routes



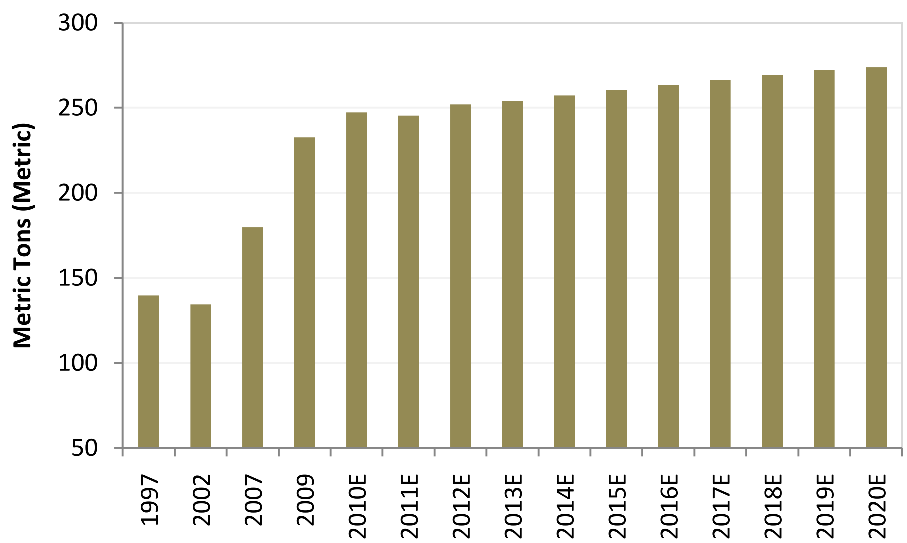
10. Outlook for Key Commodities

A brief outlook will be provided for the main commodities that are likely to be barged.

Agriculture

According to forecasts prepared by the USDA, crop production (Corn, Wheat and Soybeans) in MRB is estimated to increase from approximately 250 million metric tons (MMT) in 2010 to 275 MMT by 2020 as illustrated in Figure 33. This implies an average annual increase of 1.0% over the next 10 years.

Figure 33: Crop Production Forecasts for MRB



Source: USDA; Moffatt & Nichol

Corn production accounts for the vast majority of total production tonnage within MRB, contributing 193.4 MMT to 2010's total regional production volume. This crop has helped the US become the world's largest exporter of corn which according to the same set of USDA forecasts, are estimated to increase by an average 1.5% annually over the next ten years. Japan is estimated to remain the top importer of corn, followed by Mexico and South Korea, implying that the North Asia trade route will remain a coveted destination for global corn exporters. The Caribbean and South America are also estimated to remain strong importers. This will continue to favor US corn exporters with access through the West and Gulf Coast ports.

Soybean production in the study region accounts for the second largest crop in terms of produced tonnage. Exports of these are forecasted to increase by an average 2.7% annually over the next decade. US exports of soybeans are currently 50% larger than that of corn. China is assumed to remain the strongest source of import demand, followed by Mexico and Japan. Increased use for bio-diesel and animal feed is estimated to keep global demand for soybeans strong.

The stable outlook for grain production in MRB should continue to support demand for fertilizer products within the region. These predominantly come from outside the region, and account for a large share of the total volume coming into the region by weight. Given the importance of the timely application of these goods, it is has become essential that a reliable and consistent freight corridor be established to ensure accurate delivery schedules. This has proven to be a detriment to movements on the Missouri River which is subject to unpredictable season draft limitations.

Coal

Coal movements through the MRB region are recognized to primarily come from outside the region and are associated with electricity generation. These volumes are assumed to originate from the east side of the Mississippi River and the western US, based on data provided by the Energy Information Agency's (EIA) provided in Table 12. The majority of this volume is currently carried by rail. The largest river volumes originate in Illinois.

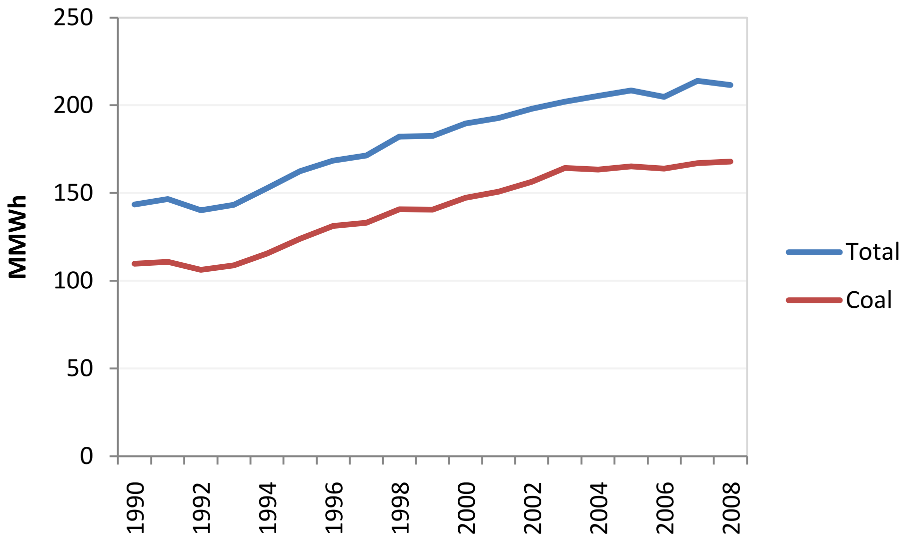
Table 12: Coal Imports into MRB by State of Origin and Mode (2008 Tons)

Origin State	Transportation Mode			
	Railroad	River	Truck	Total
Colorado	403,724	42,505	39,596	485,825
Illinois	705,868	757,470	1,236,795	2,700,133
Indiana	10,306	70,477	156,670	237,453
Kansas	706		89,413	90,119
Kentucky (East)	54,236	16,290	33,053	103,579
Kentucky (West)	528,952	184,704	43,771	757,427
Missouri	32,464		157,574	190,038
Montana	78,804			78,804
Oklahoma			182,507	182,507
Tennessee	368,227			368,227
Utah	416,347			416,347
West Virginia (Northern)		2,543		2,543
West Virginia (Southern)	7,511	11,348		18,859
Wyoming	107,776,503		202,080	107,978,583
Grand Total	**110,383,648**	**1,085,337**	**2,141,459**	**113,610,444**

Source: EIA; Moffatt & Nichol

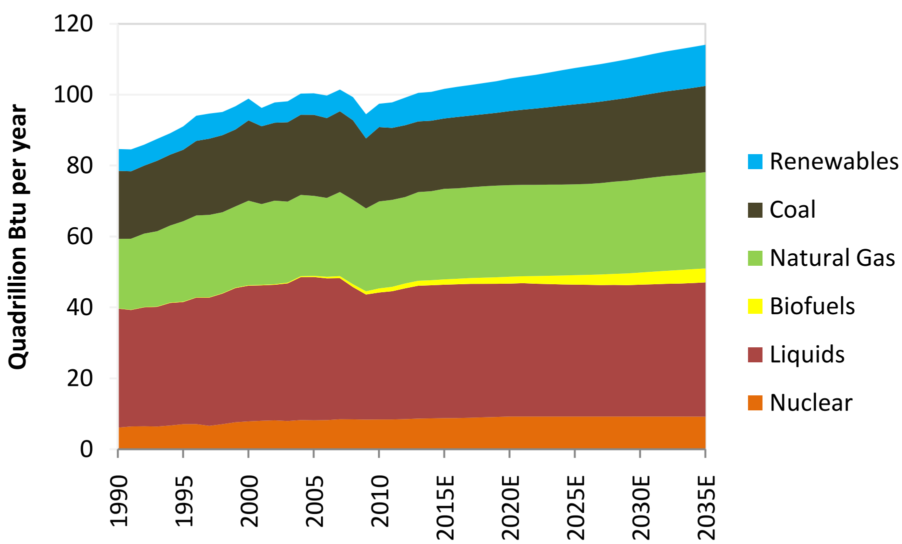
Electricity generated by coal has historically accounted for 78% of the total electricity generation in MRB over the past 20 years, as presented in Figure 34. It is likely that this share will be maintained in the long term, but could decline slightly over the next ten years based on forecasts from the EIA's 2011 Annual Energy Outlook.[viii] These forecasts signal that, at the national level, consumption of coal for electricity generation is estimated to remain essentially flat between 2010 and 2020, however long-term forecasts which extend to 2035, call for coal consumption to maintain its current share of total energy consumption of 21% as illustrated in Figure 35.

Figure 34: Electricity Generation in MRB (Million Megawatt Hours)



Source: EIA; Moffatt & Nichol

Figure 35: Primary Energy Consumption Forecasts



Source: EIA

Aggregate, Sand and Gravel

The use of aggregate, sand and gravel in MRB are predominantly associated with regional construction activity. While it is assumed that some volume is used in the construction in the residential sector the majority of use occurs on sites of large non-residential and heavy construction projects. These include private, state and federally funded projects.

11. Appendix 1: County Data Dictionary

County Data Dictionary
by 3-, 4-, 5-, and 6-Digit NAICS Codes

Note: In the filenames, [YR] is the 2-digit data year. Each data field is separated by comma (,) delimiters.

NOTE: "EMPFLAG" (Data Suppression Flag) field denotes employment size class for data withheld to avoid disclosure (confidentiality) or withheld because data do not meet publication standards.

Field Name	Data Type	Description
FIPSTATE	C	FIPS State Code
FIPSCTY	C	FIPS County Code
NAICS	C	Industry Code - 6-digit NAICS code.
EMPFLAG	C	Data Suppression Flag

This denotes employment size class for data withheld to avoid disclosure (confidentiality) or withheld because data do not meet publication standards.

A	0-19
B	20-99
C	100-249
E	250-499
F	500-999
G	1,000-2,499
H	2,500-4,999
I	5,000-9,999
J	10,000-24,999
K	25,000-49,999
L	50,000-99,999
M	100,000 or More

Field Name	Data Type	Description
EMP_NF	C	Total Mid-March Employees Noise Flag (See all Noise Flag definitions at the end of this record layout)
EMP	N	Total Mid-March Employees with Noise
QP1_NF	C	Total First Quarter Payroll Noise Flag
QP1	N	Total First Quarter Payroll ($1,000) with Noise
AP_NF	C	Total Annual Payroll Noise Flag
AP	N	Total Annual Payroll ($1,000) with Noise

```
EST             N       Total Number of Establishments

N1_4            N       Number of Establishments: 1-4 Employee Size Class

N5_9            N       Number of Establishments: 5-9 Employee Size Class

N10_19          N       Number of Establishments: 10-19 Employee Size Class

N20_49          N       Number of Establishments: 20-49 Employee Size Class

N50_99          N       Number of Establishments: 50-99 Employee Size Class

N100_249        N       Number of Establishments: 100-249 Employee Size Class

N250_499        N       Number of Establishments: 250-499 Employee Size Class

N500_999        N       Number of Establishments: 500-999 Employee Size Class

N1000           N       Number of Establishments: 1,000 or More Employee Size
Class

N1000_1         N       Number of Establishments: Employment Size Class:
                                1,000-1,499 Employees

N1000_2         N       Number of Establishments: Employment Size Class:
                                1,500-2,499 Employees

N1000_3         N       Number of Establishments: Employment Size Class:
                                2,500-4,999 Employees

N1000_4         N       Number of Establishments: Employment Size Class:
                                5,000 or More Employees

CENSTATE        C       Census State Code

CENCTY          C       Census County Code

NOTE: Noise Flag definitions (fields ending in _NF) are:

        G       0 to < 2% noise (low noise)
        H       2 to < 5% noise (medium noise)
        D       Withheld to avoid disclosing data for individual companies; data
are included in higher level totals. Employment or payroll field set to zero.
        S       Withheld because estimate did not meet publication standards.
Employment or payroll field set to zero.
```

12. Appendix 2: Economic Overview Appendix

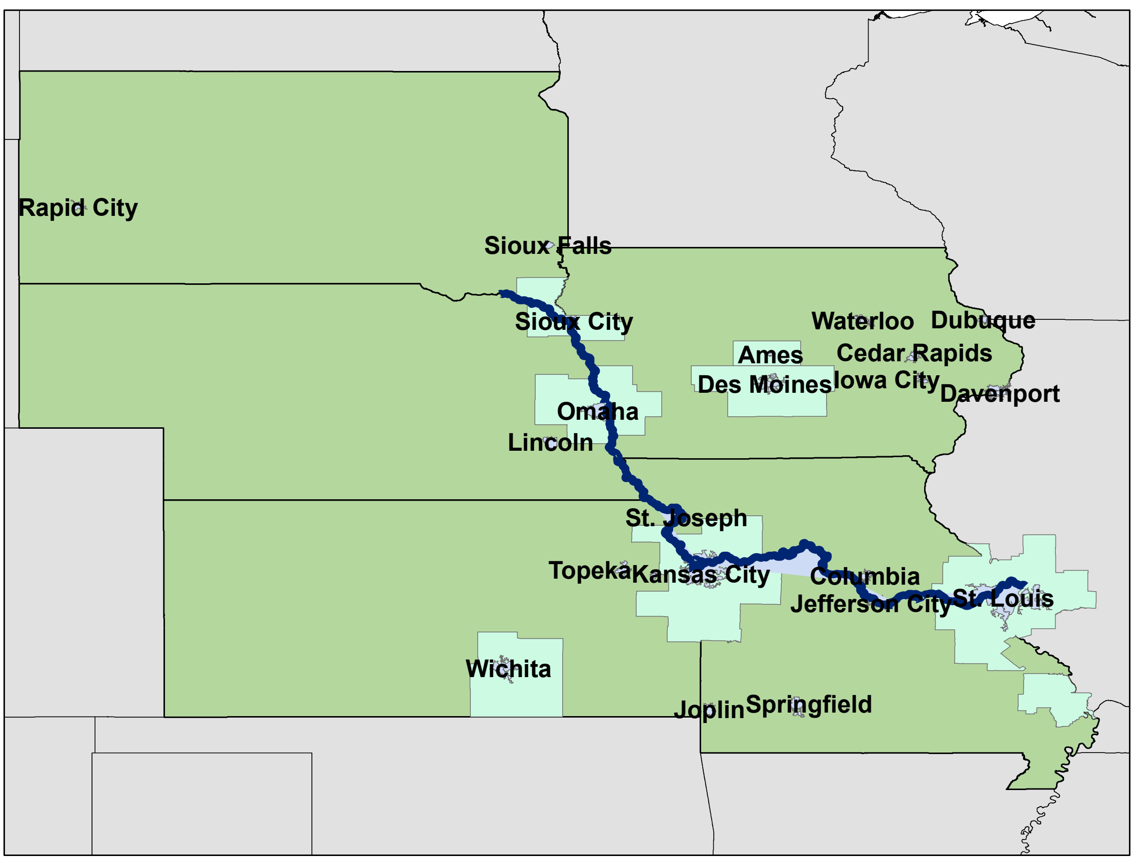
12.1. Geographic & Trade Volumes

As noted in the Executive Summary, Moffatt & Nichol considers the region of interest to be the territory encompassed by:

- Missouri
- Iowa
- South Dakota
- Nebraska
- Kansas

These states border the navigable portion of the Missouri River, and are most pertinent to assessing potential commercial activity.

Figure 36: MRB Region (Selected States Denoted in Dark Green)



Moffatt & Nichol has used data from FAF, to determine the level of trade which occurs with MRB. As discussed, the FAF data provides volume of trade by commodity, mode, and direction (import & export, domestic & foreign) between geographic regions.

Trade volume which originates in and is destined to MRB, by direction is presented Table 13 and Table 14.

The majority of trade volume which originates in MRB is destined to locations within the region, as noted in Table 13. These represent Intra-regional moves, or comparatively short distance routes, and therefore it is not surprising that 95% of this trade is carried on trucks. While there are some of these Intra-regional volumes being barged, given the speed and versatility advantage of trucking within a small geography, it is unlikely that much of this Intra-regional volume will be switched over to barge.

For the remaining Inter0 trade volume, which is destined to locations outside MRB, the greatest share is headed to the South of which approximately 25% of the total is carried by barge. Nevertheless, the combined volume carried by rail and truck still accounts for the majority of trade destined to the South, roughly 65%, and therefore it would be assumed that in this combined tonnage there are likely some shipments which could benefit from switching to barge. The South is also the most import gateway region for international exports originating within the MRB, accounting for almost half of the total, and therefore barge movements could be incorporated into international supply chains.

Table 13: Shipments Originating in MRB (Tons 1,000s)

Mode	East	MRB	North	Northeast	Northwest	South	Southeast	Southwest	West	Total
Truck	47,705	1,012,440	54,010	8,113	6,985	40,481	6,482	2,121	11,439	**1,189,777**
Rail	6,275	20,241	7,632	5,678	5,122	43,693	2,561	1,840	12,844	**105,887**
Water*	8,882	4,114	0	8	41	30,261	3,213	5	2	**46,527**
Air (include truck-air)	14	14	4	16	6	11	13	0	24	**102**
Multiple modes & mail	4,827	6,112	1,530	1,233	899	7,924	1,189	381	4,596	**28,690**
Pipeline	1,899	4,687	1,012	1,268	1,092	5,139	810	383	1,956	**18,246**
Other and unknown	496	14,155	352	301	135	1,371	98	65	829	**17,801**
Total	**70,098**	**1,061,762**	**64,540**	**16,616**	**14,281**	**128,881**	**14,366**	**4,795**	**31,690**	**1,407,030**

Type	East	MRB	North	Northeast	Northwest	South	Southeast	Southwest	West	Total
Domestic Only	69,478	1,061,734	53,173	15,425	10,753	107,972	13,800	4,648	28,988	**1,365,970**
Import	1	20	0	0	0	0	0	0	0	**21**
Export	619	9	11,367	1,191	3,527	20,909	566	148	2,702	**41,039**
Total	**70,098**	**1,061,762**	**64,540**	**16,616**	**14,281**	**128,881**	**14,366**	**4,795**	**31,690**	**1,407,030**

* Includes Iowa and St. Louis volumes carried on the Mississippi River
MRB as a column header indicates within MRB flows
Source: FAF; Moffatt & Nichol

As identified in **Table 13**, the majority of MRB's total trade volumes are Intra-regional moves, originating and destined to locations within MRB. Therefore, in the MRB column of **Table 14** the same volume of trade by mode and type is shown as in **Table 13**.

For the remaining Inbound trade, which originates outside the MRB, the majority of this volume is carried by rail from the Northwest. This region is not readily accessible via inland waterways. The East and South also account for a large share of Inbound trade, of which most of the respective volumes are carried by truck; though not surprisingly there is a significant volume of pipeline commodities, presumably petro goods, originating in the South as well. While these petro goods could potentially be carried via barge, these would have to compete with existing low cost pipeline services.

Table 14: Shipments Destined to MRB (Tons 1,000s)

Mode	East	MRB	North	Northeast	Northwest	South	Southeast	Southwest	West	Total
Truck	45,406	1,012,440	37,911	4,996	5,107	29,600	4,700	1,314	8,055	**1,149,528**
Rail	6,242	20,241	8,796	181	103,256	10,019	1,396	186	4,435	**154,753**
Water*	1,711	4,114	0	0	496	845	0	0	0	**7,167**
Air (include truck-air)	8	14	2	8	1	3	1	1	6	**43**
Multiple modes & mail	6,064	6,112	1,128	520	29,061	1,470	336	66	1,832	**46,587**
Pipeline	6,122	4,687	1,164	1,998	5,031	15,689	579	1,900	2,733	**39,904**
Other and unknown	203	14,155	290	71	25	223	29	17	214	**15,226**
Total	**65,757**	**1,061,762**	**49,290**	**7,774**	**142,978**	**57,848**	**7,041**	**3,483**	**17,276**	**1,413,209**

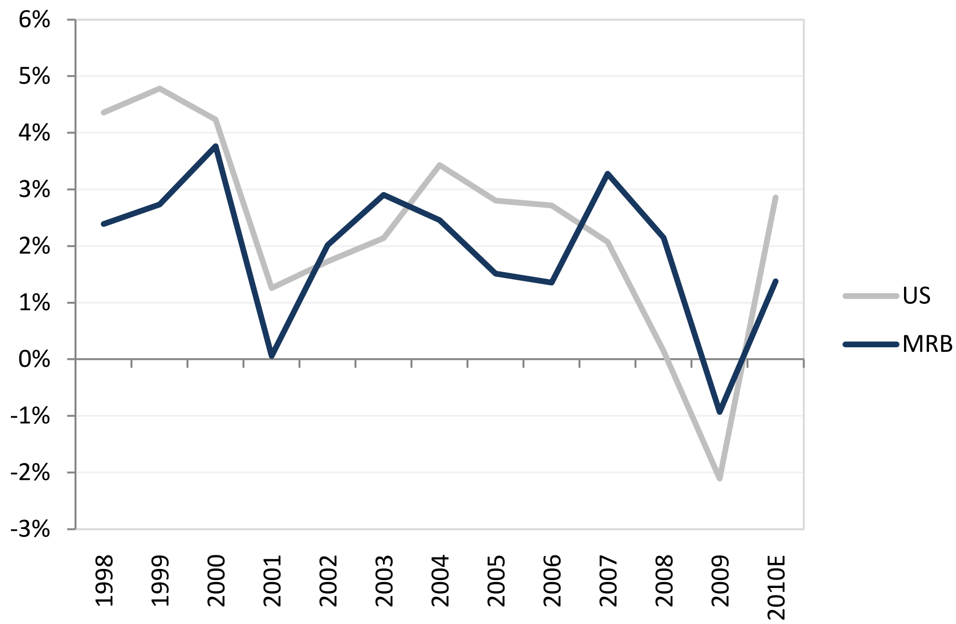
Type	East	MRB	North	Northeast	Northwest	South	Southeast	Southwest	West	Total
Domestic Only	64,972	1,061,734	42,867	6,594	141,718	55,422	6,422	3,470	15,207	**1,398,406**
Import	784	20	6,423	1,180	1,260	2,427	619	13	2,069	**14,794**
Export	0	9	0	0	0	0	0	0	0	**9**
Total	**65,757**	**1,061,762**	**49,290**	**7,774**	**142,978**	**57,848**	**7,041**	**3,483**	**17,276**	**1,413,209**

* Includes Iowa and St. Louis volumes carried on the Mississippi River
Source: FAF; Moffatt & Nichol

12.2. Economics

MRB's Real Gross Domestic Product (GDP, excludes inflation) has accounted for an average 4.4% of the national total over the past three years for which data is available. This share is down slightly from an average 4.6% during the late 1990's, suggesting that economic growth within the study region has slightly lagged that of the rest of the country over the past decade. This is due in part to the region's relatively lower exposure to the sectors which led periods of high national growth, namely the technology boom in the late 1990's and housing in the latter half of the 2000's. This relative exposure has, however, helped the region remain comparatively more stable during this same period as identified Figure 37, and has allowed it to fare comparatively better in the most recent downturn.

Figure 37: Annual real GDP growth for the US and MRB

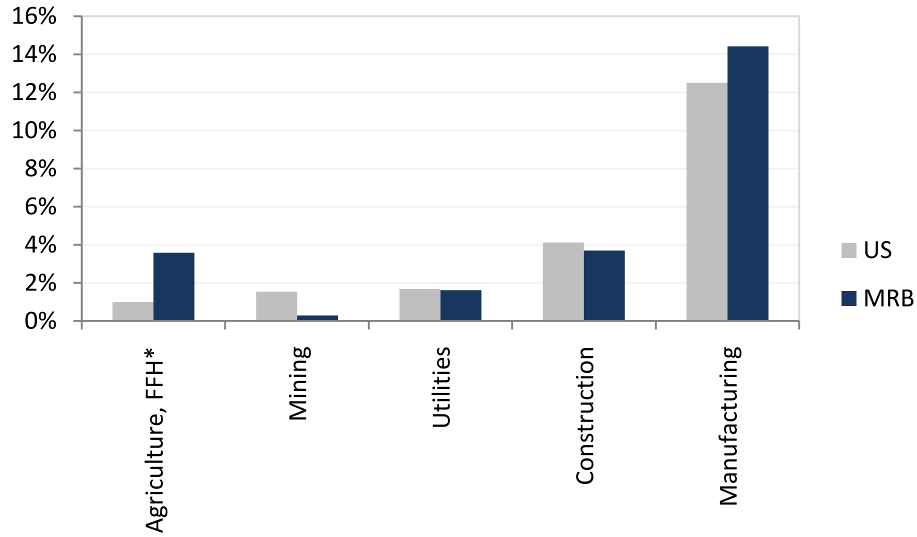


Source: Bureau of Economic Analysis; Moffatt & Nichol

MRB's economy has a greater exposure to the Agriculture and Manufacturing broad sectors by comparison to the US as a whole, as illustrated in Figure 38.

This Page Intentionally Left Blank

Figure 38: Composition of GDP by Broad Sectors (2009)



Source: Bureau of Economic Analysis; Moffatt & Nichol

As discussed earlier in the report, trade volumes to and from MRB will be driven by the production output of the region's industries, as well as by demand for and consumption of intermediate production inputs and final goods. The commodity being shipped will be determined by the industry by which it is being either produced or demanded. Therefore, Table 15 through Table 17 present the top goods producing industries and intermediate inputs within the MRB region. These lists are provided in the context of regional production and consumption/attraction.

Production

Table 15 provides a list of the top 20 goods producing industries in the study area by value in 2007, as Moffatt & Nichol estimates using data from the CBP. The industry mix is quite broad encompassing high-value electronics manufacturing to high-value food products. There are several liquid bulk industries as well, which could lend themselves to potential barge, assuming seasonal shipments are permitted. Agriculture is not listed as it is not part of the CBP data set.

Not surprisingly the industries with the greatest production values include high value commodities such as autos, aircraft and construction machinery manufacturing. Other large industries include chemicals, pesticides, plastics and animal products.

Table 15: Top 20 Goods Producing Industries by Value of Shipments: 2007, millions of dollars

Rank	NAICS	NAICS Definition	Value
1	336112	Light Truck and Utility Vehicle Manufacturing	24,173.65
2	311611	Animal (except Poultry) Slaughtering	18,940.87
3	336411	Aircraft Manufacturing	12,350.66
4	333120	Construction Machinery Manufacturing	10,321.16
5	325193	Ethyl Alcohol Manufacturing	9,421.69
6	324110	Petroleum Refineries	9,168.86
7	333111	Farm Machinery and Equipment Manufacturing	8,688.34
8	325412	Pharmaceutical Preparation Manufacturing	6,900.72
9	336111	Automobile Manufacturing	5,353.83
10	334511	Search, detection, navigation, guidance…instrument manufacturing	4,910.52
11	511110	Newspaper Publishers	4,826.03
12	325611	Soap and Other Detergent Manufacturing	4,734.11
13	326199	All Other Plastics Product Manufacturing	4,723.67
14	333415	Air-Conditioning and Warm Air Heating Equipment...Manufacturing	4,275.94
15	511120	Periodical Publishers	4,197.58
16	325199	All Other Basic Organic Chemical Manufacturing	3,687.92
17	211111	Crude Petroleum and Natural Gas Extraction	3,053.38
18	311612	Meat Processed from Carcasses	3,016.16
19	325320	Pesticide and Other Agricultural Chemical Manufacturing	3,002.45
20	331315	Aluminum sheet, plate, and foil manufacturing	2,959.38

Source: Moffatt & Nichol based on 2007 Economic Census and 2007 County Business Patterns

Table 16 shows the top 20 goods producing industries by number of establishments within the study area. The list looks very different from Table 15 above in that it is composed of a very broad mix of goods with a much lower average production value. It also includes more heavy-bulk/low-value of goods industries in mining, forest products, quarried products including crushed stone, and natural sands.

Table 16: Top 20 Goods Producing Industries by Number of Establishments

Rank	NAICS	NAICS Definition	Establishments
1	332710	Machine Shops	1,016
2	511110	Newspaper Publishers	891
3	323110	Commercial Lithographic Printing	692
4	327320	Ready-Mix Concrete Manufacturing	594
5	337110	Wood Kitchen Cabinet and Countertop Manufacturing	564
6	211111	Crude Petroleum and Natural Gas Extraction	419
7	511120	Periodical Publishers	366
8	326199	All Other Plastics Product Manufacturing	358
9	339950	Sign Manufacturing	354
10	323114	Quick Printing	329
11	339116	Dental Laboratories	326
12	212312	Crushed and Broken Limestone Mining and Quarrying	318
13	323113	Commercial Screen Printing	299
14	311611	Animal (except Poultry) Slaughtering	291
15	333111	Farm Machinery and Equipment Manufacturing	288
16	321113	Sawmills	264
17	311119	Other Animal Food Manufacturing	264
18	321920	Wood Container and Pallet Manufacturing	240
19	332312	Fabricated Structural Metal Manufacturing	223
20	212321	Construction Sand and Gravel Mining	209

Source: Moffatt & Nichol based on 2007 County Business Patterns

With respect to intermediate goods consumption, detailed I/O direct requirement coefficients from the 2002 benchmark are applied against the production output estimates. Table 17 below shows the top 20 manufactured commodities as inputs as part of production, based on BEA definitions, for the study area. Agriculture, mining, construction and utilities are excluded from the table as Agriculture was not included in the CBP and the value of construction and utility output is assumed to be equal to the value intermediate input.

Table 17: Top 20 Manufactured Commodity Inputs by Value

Rank	Commodity	Commodity Description	Value
1	336300	Motor vehicle parts manufacturing	16,473
2	331110	Iron and steel mills and ferroalloy manufacturing	5,422
3	31161A	Animal … slaughtering, rendering, and processing	4,322
4	325190	Other basic organic chemical manufacturing	4,138
5	324110	Petroleum refineries	2,659
6	32619A	Other plastics product manufacturing	2,549
7	325211	Plastics material and resin manufacturing	2,386
8	322120	Paper mills	2,345
9	325110	Petrochemical manufacturing	2,317
10	334413	Semiconductor and … manufacturing	2,275
11	322210	Paperboard container manufacturing	2,068
12	336412	Aircraft engine and engine parts manufacturing	1,943
13	336413	Other aircraft parts … equipment manufacturing	1,879
14	333618	Other engine equipment manufacturing	1,805
15	326110	Plastics packaging materials … manufacturing	1,495
16	33131A	Alumina refining and primary aluminum production	1,414
17	33291A	Valve and fittings other than plumbing	1,375
18	334418	Printed circuit assembly ... manufacturing	1,324
19	332710	Machine shops	1,321
20	33131B	Aluminum product manufacturing …	1,231

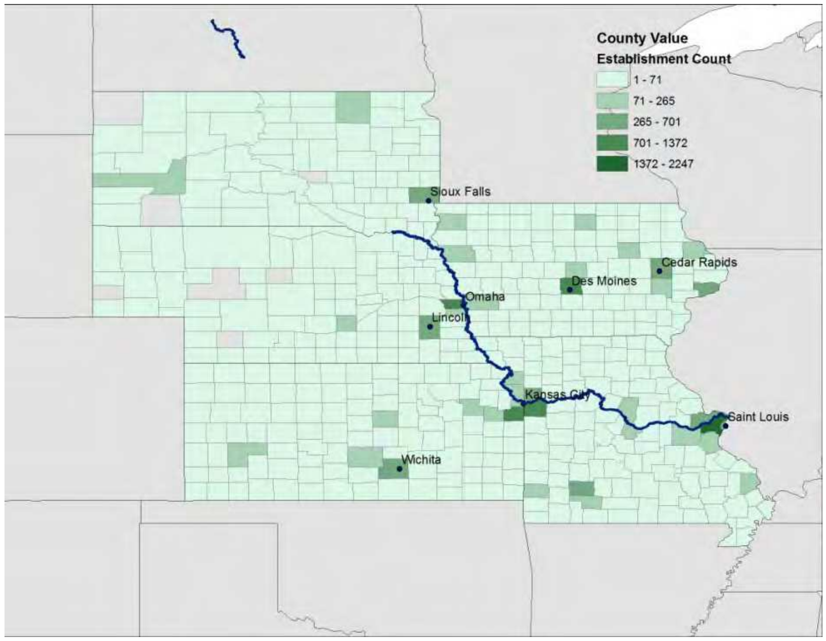
Source: Moffatt & Nichol

Consumption

Moffatt & Nichol evaluates goods attraction based primarily on consumer goods and goods required for intermediate production. Goods consumption by households is based on retail sales which are realized in the form of final goods sold. As discussed in the model process, these goods can be handled by smaller retail establishments or indirectly via wholesalers.

Figure 39 provides concentrations in the wholesale industry within MRB. As expected, the highest concentrations of firms are located in direct proximity to urban areas. The study area does have a large number of wholesale firms located throughout it. This is due to the area's high level of production of agricultural goods, which are largely traded through wholesale firms.

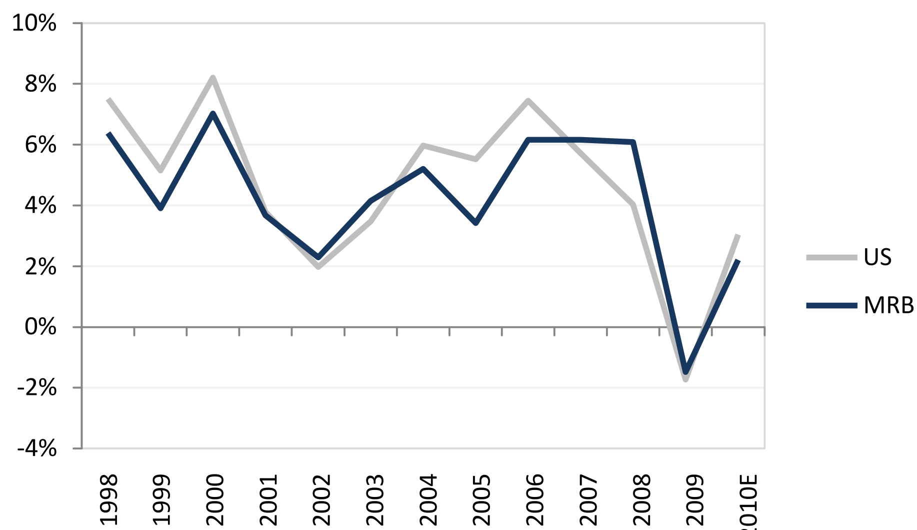
Figure 39: County Distribution Wholesale Establishments



Source: Moffatt & Nichol based on 2007 Economic Census and 2007 County Business Patterns

As illustrated in Figure 40, regional income growth tends to trend with the national pattern. Since 1998 income in MRB has grown at a 4.4% CAGR as compared to the 4.7% CAGR experienced nationally. Therefore it would be expected that future retail sales within the regional should trend with or slightly below the national average.

Figure 40: Growth of Personal Income for US and MRB



Source: Bureau of Economic Analysis

Capital Goods: In order to evaluate the possibility of capturing capital goods on the river, Moffatt & Nichol will look at the large project cargos presently being transported, their origin & destinations and current routes. Project cargos are difficult to redirect because large investment in lift equipment is often required to handle these goods. Table 8 provides a summary of some of the more expensive project cargos by industry.

Table 18: Top 10 Project Cargos by Unit Value, exclude Military and Watercraft

Rank	Harmonized Code Definition	Industry	Handling
1	SELF-PROPELLED RAILWAY OR TRAMWAY COACHES, ELECTR	Rail	Ro-Ro
2	TURBINES, STEAM & OTHER VAPOR,OVER 40 MW,N.E.S.O.I	Energy	Heavy lift
3	DIESEL ELECTRIC LOCOMOTIVES	Rail	Ro-Ro
4	TURBOJETS OF A THRUST EXCEEDING 25 KN	Aircraft Parts	Heavy lift
5	TURBINES, STEAM AND VAPOR,NOT OVER 40 MW,N.E.S.O.I	Energy	Heavy lift
6	GENERATING SETS, ELECTRIC, WIND-POWERED	Energy	Heavy lift
7	GAS TURBINES OF A POWER EXCEEDING 5,000 KW	Energy	Heavy lift
8	RAILWY, TRAMWY PASS ETC COACHES NOT SELF-PROPELLD	Rail	Ro-Ro
9	LIQ DIELECT TRANSFRM POWER HAND CAP > 10T KVA	Energy	Ro-Ro
10	SELF-PROPELLED RAILWAY OR TRAMWAY COACH NESOI	Rail	Ro-Ro

Source: Moffatt & Nichol

Wind Cargo

Given the strong effort to develop wind farms in the MRB region, these commodities represent the best opportunity for potential large scale capital equipment movements on the Mississippi and Missouri River. The largest component is ranked number 2 in the Table 18: TURBINES, STEAM & OTHER VAPOR, OVER 40 MW,N.E.S.O.I.

Table 19: Wind Energy Rankings by State for the Study Area, Megawatts

State	Existing	Under Construction	Rank (Existing)
Iowa	3,670	0	2
Kansas	1,026	0	14
Missouri	457	0	17
South Dakota	412	210	20
Nebraska	153	264	25

Source: American Wind energy Association

The transportation of these commodities is typically relegated to specialized logistics routes, which are chosen because of their ability to provide access to the required heavy lift equipment and transportation on unimpeded (air draft, road/bridge weight limitations) landside routes.

Reliance on specialized equipment is evidenced in the US Census Bureau's trade data which indicates that Ports in the Gulf and the Columbia Snake River area have handled over 80% of the US's international trade volumes of the wind turbine components over the past seven years (period for which data was available.) These ports have made significant investments in their heavy lift capabilities. Given the size of the components of the turbines, Nacelles can weigh up to 90 tons, it is necessary that the proper equipment be in place.

Similarly, in order to transport shipments of this size over the US road system specialized permits must be acquired prior to movement. As weight restrictions and permitting processes can vary from state to state the planning of the logistics route can become a long and expensive process in and of itself. Additionally, the load limitations and congestion concerns can result in longer transportation routes adding to total transportation costs.

As barge service is not subject to these same permitting issues, the opportunity for barge movement to help alleviate some of these planning hurdles becomes increasingly attractive.

Nevertheless, the challenge of increasing wind-related barge traffic on the Mississippi and Missouri Rivers remains:

- A coordinated effort to attract international trade volumes would need to include the Port of New Orleans.
- Significant path momentum through the Texas gulf ports currently exists and would have to be overcome.
- Wind farm developments would have to be located adjacent or near access to the Missouri River

Despite these obstacles there is a push in other regions to develop intermodal logistic routes which include barge.

On the Columbia-Snake River, the Port of Vancouver is currently working to develop a new project cargo route to the Canadian Oil Sands. Large Generator units are required to power exploration equipment. These units have traditionally moved through Texas ports because of the port’s heavy lift equipment and proximity to back roads that allow unimpeded travel to the Canadian Rockies.

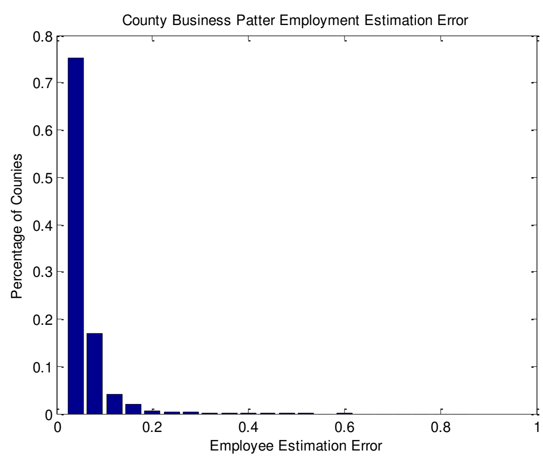
If successful, the Port of Vancouver would transfer these modules from an ocean going vessel to barge where they would travel to the top of Idaho and be transferred via truck for the remaining leg to the Oil Sands region in Canada. Presently, a lawsuit has been filed to restrict trucks from traveling via scenic Idaho roads to the Oil Sands Region. If the suit prevails, the Texas ports will maintain a monopoly on this type of cargo.

13. End Notes

[i] "County Business Patterns is an annual series that provides subnational economic data by industry." "Data are available for each state, county, metropolitan area, the District of Columbia, and the Commonwealth of Puerto Rico (including each municipio), plus a U.S. summary. Data include number of establishments by employment size class and 6-digit NAICS, quarterly and annual payroll, and employment during the week of March 12." "The series excludes data on self-employed individuals, employees of private households, railroad employees, agricultural production employees, and most government employees."

[ii] if the data was suppressed in this level the mean value of firm size will be used as an estimator

[iii] More than 90% of employment information at the NAICS6 level can be estimated with less than 10% of error at county level, in the below figure.



In order to estimate the number of employees per firm, average employee counts for each employment range is calculated, and then use an iterative solving to control this mean value so to match the employment level at the reported at the next hierarchal level of NAICS within the specific county. Employment estimates at the firm level must also balance across all counties within the state to match the state level estimate for number of employees within the employment range for that six digit NAICS.

[iv] The Economic Census provides a detailed portrait of the United States' economy once every five years, from the national to the local (County) level. It covers most of the U.S. economy in its basic collection of establishment statistics. It publishes basic data measures (number of establishments, sales, payroll and number of employees) by industry code (NAICS) and geographic area, as well as by other dimensions such as sales size and legal form of organization and covers nearly all businesses and industries in the private, non-farm U.S. Economy.

[v] The Benchmark I-O tables are released by the BEA in 5-year intervals and are based on the data from the Economic Census conducted by the Census Bureau, also in five year intervals. These accounts provide the most detailed information available on the structure of the U.S. economy and its industries, covering over 400 industries. They illustrate the interdependence between producing and consuming industries with in the economy. Among other measurements including the distribution of sales for each good and service to final user, and the income earned by each industry, the value of production of goods and services by industry and commodity is accounted with the purchase of goods and services d by each industry thereby creating a coefficient of required input needed for the production of output for all industries and commodities.

[vi] This information includes the product line, product line sales, product lines sales as a percentage of total sales of the establishment and sales of the establishments reporting product line sales as a percentage of total sales.

[vii] County-to-County distances were sourced from the Oak Ridge National Laboratory (ORNL) matrix of distances and network impedances. Known as a “skim tree” this data set provided the distances between county centroids via highway, railroad, water, and combined highway-rail paths. This data set was produced in 2002.

[viii] http://www.eia.doe.gov/forecasts/aeo/early_fuel.cfm