INSUFFICIENT FREIGHT

An Assessment of U.S. Transportation Infrastructure and Its Effects on the Grain Industry

WRITTEN BY

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EXECUTIVE SUMMARY

Waiting three minutes for 110 train cars of oil to pass a rail crossing may just seem like one of life's inevitable little annoyances. But as these seemingly small irritations occur with ever-increasing frequency across the United States, they have become a hallmark of the strain that plagues America's entire freight system.

A host of commodities have all been crowding our freight infrastructure at a time when some shipping routes weren't growing quickly enough to accommodate demand (railroad infrastructure), some shipping routes were held up by political uncertainty (pipelines), and some simply had limited physical capacity (barge shipping on the Mississippi River). Alongside larger shipments of coal and container traffic, the agriculture industry contributes to the overall congestion with its tendency to produce ever-larger record-sized harvests of grains, oilseeds, and their byproducts. But it is the surge in crude oil shipments from the Bakken formation in North Dakota that presents the most concern.

The region where rail traffic of crude oil has grown the most covers exactly the same states we think of as the Upper Midwest states – Minnesota, South Dakota, North Dakota, and Montana. As rail congestion continues to worsen, especially if the main driver of that congestion is additional crude oil traffic, grain producers in the Upper Midwest states will feel the effects.

Unfortunately, the agriculture industry is uniquely dependent on efficient rail freight systems in the hotspots most affected by congestion. Some North Dakota grain elevators, for instance, entirely rely on rail shipment to keep business flowing. Rail congestion in 2014 stopped service to them for weeks and months at a time – a total collapse in the system that supports their livelihood. Ultimately, family farmers bore the costs of scarce rail service. The USDA estimates grain and oilseed producers throughout the Upper Midwest may have received $570 million less for the crops they marketed in 2014 than they could have earned in a normal freight environment.

Elevators and farmers throughout the Corn Belt also worried about rising freight costs and the likelihood that congestion will spread and worsen. Meanwhile, end users paid more for agricultural products with less reliable delivery.

There is no question that freight volumes will continue to rise and crude oil will be transported from Canada and North Dakota to find demand points along the U.S. coasts. Our duty is to consider which alternatives for expansion of the U.S. transportation infrastructure will provide the best results for the agriculture industry while causing the least harm to communities and natural resources.

The mathematically simulated scenarios in this paper show that every expansion of any freight method — truck, rail, barge, or pipeline — can reduce overall congestion and improve the annual volume of grain moved. It's unpredictable how freight prices would specifically respond to these expansions. Due to the nature of grain production and use, the industry is fairly inflexible about which freight methods it must use.

Therefore, opportunities for system-wide freight capacity improvement must come from other commodities, specifically from oil and industrial products, which can be channeled off the truck / rail / barge system entirely and moved into pipelines for certain routes. These are the only commodities capable of being moved by this cheaper, safer form of transportation, and pipelines are the one form of transportation that is best suited to expansion in the United States without crowding already overstressed rail terminals and highways.

Current pipeline proposals would relieve freight congestion at precisely the Upper Midwest hotspots that were most problematic for the grain industry during the 2013 and 2014 marketing years.

EFFECTS ON GRAIN MARKETS

HOW FREIGHT FITS INTO PRICE

In order to substantiate the overall costs of freight congestion to the industry, first let's understand how each freight transaction affects an agricultural producer's or consumer's bottom lines. As freight availability gets scarcer, freight itself gets more expensive, and ag profits fall.

The market for corn, our largest crop, provides a good example. One common route for a bushel of corn would be to travel by truck from the farm where it was grown to a local grain elevator, then by rail to an export facility, then by ocean vessel to a foreign buyer.

Before a Korean chicken or Japanese dairy cow chews that corn, the bushel will have carried many different price tags. In mid-2014, a Minnesota elevator may have paid a farmer $3.84 per bushel of corn, writing him a $3,648 check for a 950-bushel truckload he hauled to the local elevator. Hiring the truck perhaps cost him $285 ($0.30 per bushel), so already we have another price tag to consider: the $3.54 net value he received, equivalent to $584 per acre. This is just one example based on USDA benchmarks; in reality there were hundreds of thousands of transactions like this, each taking place when the underlying market price was eighths of a penny or a dollar higher or lower than this example, and each manifesting a different net result for the farmer as each truck drove a different number of miles using fuel that costs different amounts per gallon.

From that point, the local elevator may have sold the corn in a 385,000-bushel shuttle train load delivered to a commercial grain exporting company at a port in the Pacific Northwest (PNW). If the rail freight cost $1.43 per bushel, then the exporter must pay a price tag of at least $5.27 to cover the original cost of the grain and the cost of the freight. Ultimately, after paying for ocean shipping that costs $0.62 per bushel, a grain buyer in Japan would see an equivalent price tag of $5.89 per bushel for corn that was worth $3.54 in the farmer's field (see Figure 1).

Obviously there are other routes for corn to take, and in fact, less corn gets exported today than remains in the country to be consumed at domestic processors after just one or two rides on a truck or rail car. However, freight costs always affect the price tag in the same manner. If, in the example above, rail freight had been 10 cents per bushel more expensive, perhaps the Japanese customer would have had to pay $5.99 per bushel (driving up the input costs for his business), or the Minnesota farmer would have had to accept $3.44 per bushel (lowering the revenue of his business), or

FIGURE 1

one of the resellers along the supply chain would have had to lose money on the transaction.

Due to the way the grain markets work, it is almost always the farmer who ends up taking the loss in reality. Grain companies don't ship grain unless the transaction is profitable, and end users can scale back demand if the final price creeps too high. For the thousands of individual farmers, however, production levels aren't collectively coordinated to respond to price signals, and growing seasons are long, which essentially means that farmers must sell their product at whatever local price happens to be available. Therefore when freight costs rise, it is typically the farmer who loses money, compared to the price he could have received in a more efficient freight environment.

BASIS

The difference between the price of a physical commodity at a location and the price of the futures contract for the same commodity. Basis may be either negative or positive.

In fact, elevators explicitly set their bids to farmers based on known freight costs. Grain bids and offers are listed as basis, i.e. the difference between a specific location's price and a reference futures contract value. For example, the price for corn at the PNW port in our example could be described as a flat price of $5.27 or, if the underlying corn futures contract was priced at $4.00 that day, as a basis bid of "$1.27 over" the futures price. Meanwhile, the basis price at the Minnesota elevator would be called "16 cents under" the futures price (i.e. $3.84). The elevator would have set that bid knowing there was a price spread of $1.43 between the two locations, due to the cost of rail freight.

Basis has historically been understood as a function of transportation cost, storage and time. In theory, a location's basis value is equal to what it would cost to move the grain to or from a location where the grain's value must match the futures price (where basis = 0). So the farther away an elevator is from a futures delivery warehouse, the weaker the basis price tended to be. Since the ethanol industry has boomed in America, however, the geographical complexity of various demand points means that basis patterns don't always obey that simple theory anymore. Nevertheless, basis values still always reflect the supply and demand for grain at a specific location, plus or minus the transportation costs to move the grain from or to that location. Basis values are particularly useful as tools for comparing one area's grain market to another, or the grain market conditions of one timeframe to another.

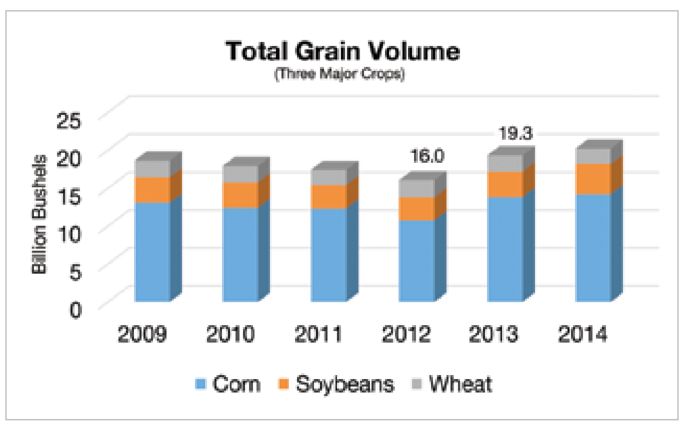
Therefore, basis values will help us see when the nation's freight system became congested and, once that happened, how transportation costs affected grain market values.

WHY BASIS BIDS WEAKENED IN 2014

Grain traffic on U.S. railway systems tends to follow a fairly predictable seasonal pattern, with strong volumes in December, January, and February trailing off to a low point in the summer, when last season's grain has mostly all been moved and the new season's grain is still growing in the fields. Volume picks up slightly in September, then jumps to the strongest months of the year: October and November, when elevators are frantically trying to move newly-harvested grain through the elevator and out on a train to make room for even more newly-harvested grain.

In 2013, the grain industry and the rail industry had been lulled into a sense of complacency after three years of disappointing yields and lower-than-expected volumes of grain to be shipped. Rail carloads of U.S. grain hit a low

FIGURE 2



point in June 2013, lower than any month of the previous five years, and the total grain shipped by rail that year, 124.5 million tons, was the lowest total since 1998.[1]

Demand for rail service by other commodity markets, meanwhile, was surging as the nation recovered from a recession. So when the record 2013 harvest hit the market in October, with 13.9 billion bushels of corn and 3.4 billion bushels of soybeans, the railroads found their capacity to move this large harvest constrained as their locomotives, crew, and track capacity had been focused on providing service elsewhere.

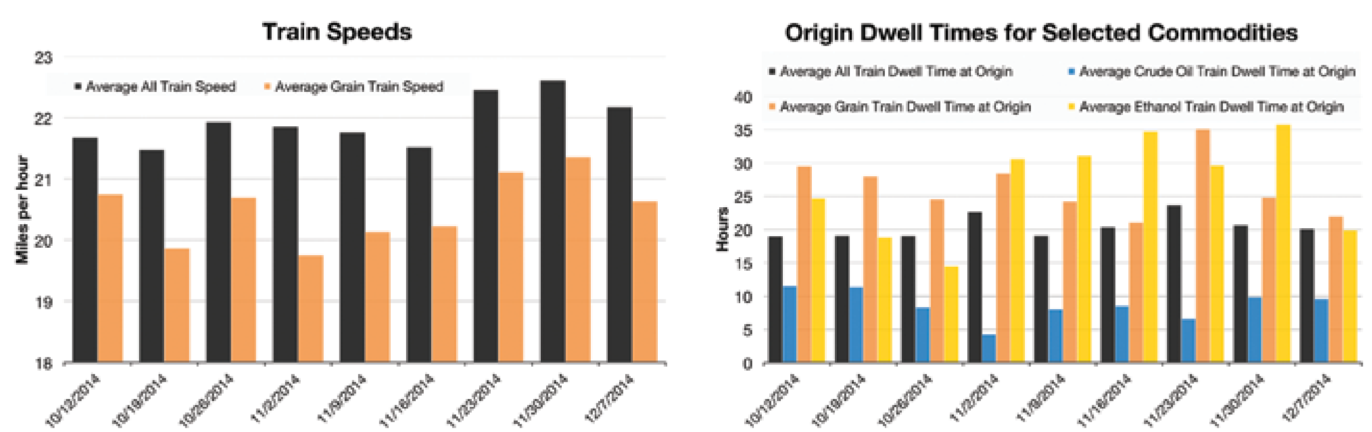
That timing is consistent with how elevators in the Upper Midwest started to experience the pain of a plugged-up freight system. While there were instances of poor rail performance to grain facilities throughout 2013, it wasn't until autumn that congestion really started to cost the industry money. Craig Haugaard, the grain manager at North Central Farmers Elevator in Ipswich, South Dakota recalls, "Dwell times started to go up at harvest-time of 2013, and our first costs were piling soybeans on the ground." Once an elevator fills a train with grain, they must wait for that loaded "dwelling" train to be hauled away by the railroad's locomotives before they can fill more cars and create more space for additional harvested grain. Without space in their elevator structures, many grain buyers in the Upper Midwest were forced to store grain in outdoor piles that were open to rain and snow, which inevitably resulted in damaging some grain, thereby losing money.

Normally, an elevator might expect a loaded train to dwell for approximately 24 hours, but after the nation's rail system became congested, North Central Farmers Elevator, for example, had loaded trains dwelling for 10 to 14 days. Farther north, the average delay for railcars in North Dakota was 29 days.

Once the harvest glut had passed, rail service delays got even worse, exacerbated as train speeds were slowed to prevent broken rails during an exceptionally cold winter. The worst delays and longest backorders occurred in March and April of 2014, but they lingered even as the next record-large grain harvest was coming onto the market. *In the last week of November 2014, during the 2014 harvest's final push of rail traffic, the average origin dwell time for grain trains was 35 hours, as reported to the Surface Transportation Board by the nation's seven Class I railroads (see Figure 3).*

The railroads have reported in Weekly Service Updates to the STB since October 2014, covering a timeframe when the worst freight congestion has largely eased, and grain shippers have received significantly better service than they did a year previously. In an anonymous survey conducted by the Soy Transportation Coalition, 70 percent of grain shippers all over the nation said their rail cycle times were faster in late November 2014 than they were the previous year. Still, a majority of shippers had past-due open orders for railcars in late November 2014, with those orders being an average of 13.4 days late. Approximately one in six survey respondents has had to stop receiving grain from farmers due to a lack of storage for anywhere from 1 day to 20 days during harvest. Others have used ground piles, storage bunkers, or grain bags to store grain while their permanent storage facilities were full.[2]

FIGURE 3



Source: Weekly Service Updates from the seven Class I railroads to the Surface Transportation Board for EP 724 – U.S. Rail Service Issues – Data Collection

Due to strong demand and limited supply, from late 2013 to the spring of 2014, rail freight costs for grain were skyrocketing. While it would have cost approximately $500 per car (plus tariff rates) to buy rail freight in late 2013, by springtime of 2014, grain shippers were bidding anywhere from $3,000 to $8,000 over tariff per car to buy rail freight. In a situation with few or no reasonable alternatives, captive rail users were frantic to pay whatever necessary to get their grain moved.

Such costs, as we've seen, have to be worked into basis and ultimately shared in lost profits throughout the industry.

HOW MUCH REVENUE WAS LOST

Facing unusual rail freight costs of $500 to $8,000 over tariff per car, grain elevators faced a choice during the height of the rail congestion crisis: either accept the losses on their own balance sheets or pass those losses along to farmers via weaker basis bids. For rail cars with a capacity of 3,500 bushels, the additional freight costs would be equivalent to as little as $0.14 per bushel or as much as $2.28 per bushel.

There is no public record of exactly how much the grain industry spent on freight during the rail congestion crisis, or exactly how many bushels of grain were shipped at any given price point. But even if only a few hopper car purchases were made at the $8,000 level, the anecdote has been set permanently in the industry's memory.

Fortunately, the USDA's Grain Transport Cost Index Calculations (see Figure 4) provides a reliable measure of rail freight costs over time. There is a clear relationship between timeframes of high national freight costs for grain shuttles (trains with more than 75 cars, all going from one origin to one destination) and timeframes with exceptionally weak basis in the Dakotas. The March 2014 short-term peak in USDA's Shuttle Cost Index was 378 on an index with 100 defined as the prices from the year 2000. That peak exactly coincides with the timeframe when average Dakota corn basis bids started to dip toward $1.00 per bushel under the futures price, averaged from 236 grain-buying locations in North Dakota and South Dakota collected and recorded daily by DTN. The weakest average Dakota corn basis value of the marketing year arrived on April 9, 2014, at $1.00 under the May corn futures contract's value.

This occurred when corn futures prices were near their highest levels of the calendar year. The average bid for corn throughout the United States was $4.69 per bushel, or 33 cents under the May futures contract price ($5.02), but in North and South Dakota at that time the average cash bid was only $4.02 per bushel. Underlying grain futures prices only fell from that point onward, and basis bids in the Dakotas never fully recovered. The lowest average price that farmers received in the region was $2.38 per bushel of corn on October 1st, 2014. Average cash bids for corn in North Dakota at that time were $2.20 per bushel, lower than they have been at any time in the post-ethanol era (late 2006 onward). Certain individual elevators posted even more extreme basis levels and cash bids — one report showed a price of $1.73 per bushel. To provide a sense of how outrageously unprofitable sales at that price level would have been, North Dakota State University estimated that corn grown with average yields and average land rent values in 2014 would cost $4.30 per bushel to produce.

Nationwide, the respondents to the Soy Transportation Coalition's survey estimated that, on average, the impact of rail service delays made their November 2014 corn basis bids 28 cents weaker than they would have been otherwise. Soybean and wheat basis bids for that same timeframe were estimated at 30 cents weaker than usual, due to rail congestion.[2]

To fully substantiate the economic effects of rail congestion on the grain markets, we need an estimate of overall grain price losses compared to what prices might have been received by farmers if shippers hadn't been faced with such punishing freight costs. Using statistical regression analysis that considered not only

FIGURE 4

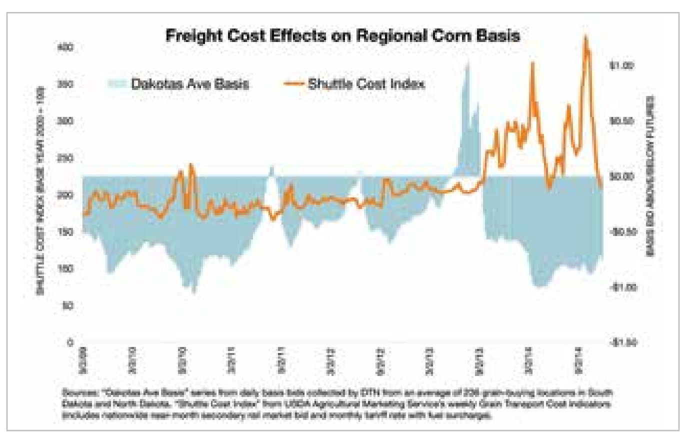
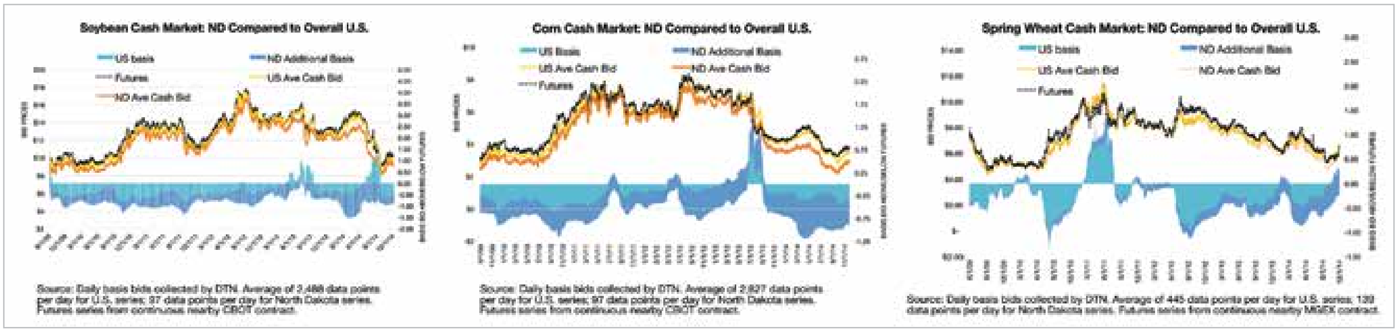


FIGURE 5



freight costs but also controlled for train speed, supply-and-demand metrics, and the price spreads between coastal destinations and Upper Midwest origins, the United States Department of Agriculture's Office of the Chief Economist was able to make a preliminary estimate of how the rail service challenges may have led to lower commodity prices received by farmers.[3]

Their analysis shows that transportation costs only explain about a third of the 2014 variation in basis away from average levels, but this is nevertheless a significant quantity. They write: "Looking at 2014, for example, the average increase in transportation costs for soybeans destined to the Gulf of Mexico from Council Bluffs, IA, relative to the prior 3 to 4 years was about $0.40 per bushel with a maximum additional increase of $1.02 per bushel. Results suggest that would have depressed local soybean prices in the Upper Midwest on average by $0.11 per bushel to as much as $0.27 per bushel more than the average change in basis did in prior years. As another example, wheat shipped from Grand Forks, ND, to Portland, OR, experienced higher transport costs in 2014, by about $0.69 per bushel on average and as much as $1.74 per bushel relative to the previous 3 to 4 years. Initial results suggest those higher transportation costs would lower spot prices paid to wheat producers by $0.18 per bushel on average and as much as $0.46 per bushel relative to the average during the previous three to four years. For corn sold by rail from Minneapolis, MN to Portland, OR, the average increase in transportation costs was approximately $0.63 per bushel rising to as much as $1.62 per bushel in 2014 relative to the previous 3 to 4 years. That could have depressed local prices by $0.17 per bushel on average in 2014, to as much as $0.42 per bushel more than expected based on the previous 3 to 4 years."

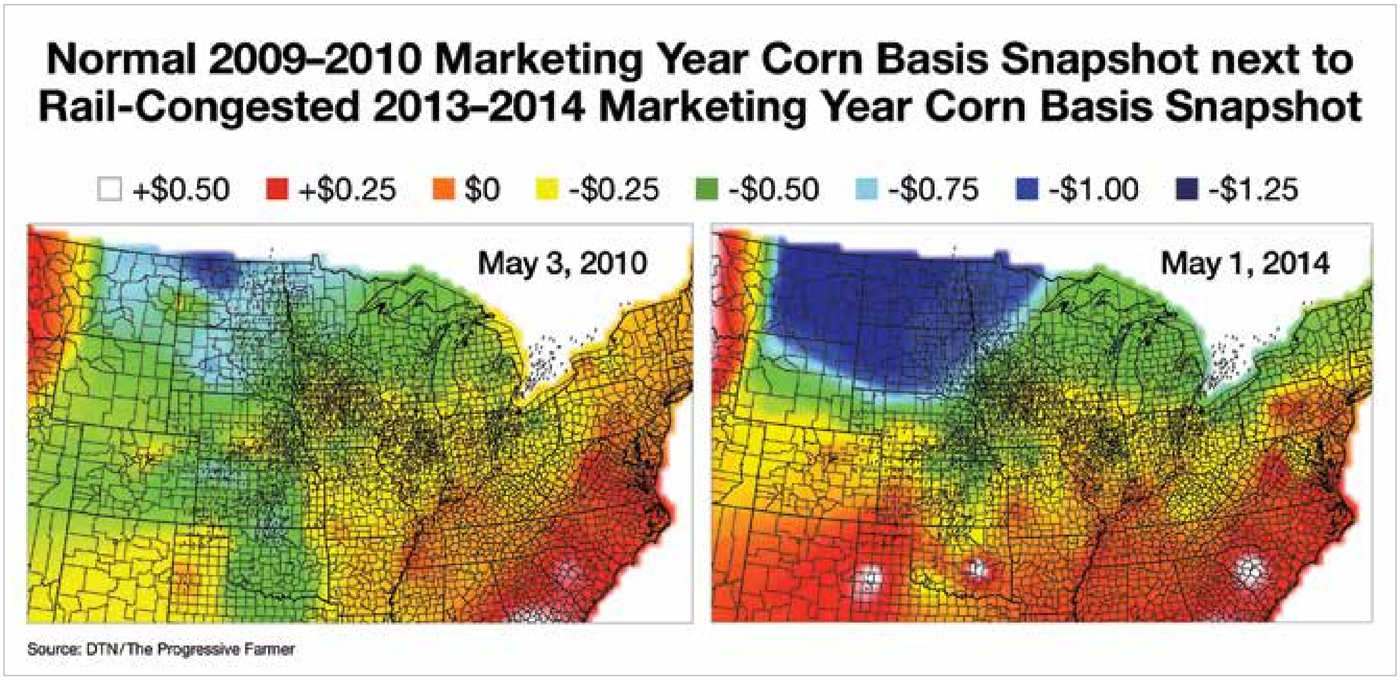
Due to rail congestion and freight costs, the USDA estimates Upper Midwest farmers may have received

$570 million less

for their crops in 2014 than they would have earned in a regular seasonal transport cost environment.

Summing up these losses on the billions of bushels of corn, soybeans, and wheat marketed by producers in Minnesota, North Dakota, South Dakota, and Montana, the USDA finds that overall farmer losses could have been as high as $570 million, or about 3 percent of cash receipts. However, they are careful to note that "the impact of higher transportation costs on farm income is complex" and the actual impacts on the region's farmers can't be perfectly calculated. For instance, farmers may not have chosen to sell their crops in their typical seasonal pattern while the prices were depressed. Furthermore, some of the grain brought to market during the freight disruption may have been contracted under a previous, higher price, so the USDA also cautions: "To the extent that railroad disruptions caused declines in commodity prices that were unanticipated, grain under forward contract would be isolated from such movements or could be stored until prices recover. Thus, even if one could isolate the spot market price impacts, that could

FIGURE 6



overstate the impact on cash receipts and farm income from the temporary shock."

Insufficient rail service and weak basis were a noted problem in the Upper Midwest region for longer than one full marketing year, starting before harvest in 2013 and lasting through the 2014 calendar year, so it would have been virtually impossible for a farmer to store away all his grain and insulate an entire year's income from the effects of this phenomenon. If an average North Dakota corn farmer produces 60,000 bushels of corn in a year and transportation costs contributed 17 cents of basis weakness to Upper Midwest corn prices in 2014, then that average farmer would have lost more than $10,000 from his corn income due to freight problems, compared to what he might have received in a normal freight environment.

The rail service challenges of 2014 may have cost the average North Dakota corn farmer

more than $10,000

off his corn receipts alone, not including other agricultural products that were also affected by freight costs.

USDA's analysis compared 2014 values to values from the three years prior to the rail crisis, but no year or timeframe can ever be a perfect representation of "normal." Volatile weather patterns, lower production, and unusual market prices were noted in 2012, for instance, so that year isn't an equitable comparison for the 2013-14 grain storage scenario. Meanwhile, looking too far back to the years prior to the 2008 financial crisis wouldn't accurately include contemporary rail traffic patterns. The 2009-10 marketing year, marked by abundant production and seasonal demand, is probably the best representation of recent "normal" basis patterns.

Figure 6 provides a snapshot showing how broadly the rail service scenario affected grain basis in the Upper Midwest. In May of 2014, the average basis bid for corn in North Dakota was $1.12 under futures, compared to the "normal" May 2010 basis of $0.68 under futures. Although basis values may have looked "normal" in the very heart of the Corn Belt in May 2014, agriculture industry participants throughout the country started to notice that inefficient freight may be a token of major economic crisis. While poor rail service made the price of grain cheaper at its origin locations, rail congestion and unreliable deliveries of grain simultaneously made end users pay more for the grain once it arrived at its destination. Regions with high demand for corn that must be shipped in from the Midwest, like the Texas Panhandle with its many cattle feedlots or the Southeast with its concentration of poultry operations were susceptible to the development of hotspots of unusually strong basis values as a result of rail congestion from the receiving end.

The most dramatic example of these costs to end users occurred in October 2014 when soybean meal prices frantically shot up 16 percent in four days, even while ample supplies of newly-harvested soybeans existed, but were stalled at Midwestern elevators waiting for rail service. Transportation inefficiency not only drives up commodity costs due to the freight charges alone, but in some instances can also spark artificial scarcity and panic-buying. Ultimately, these higher input costs for end users damage their profitability, and therefore contribute to the overall economic pain felt by the industry.

In addition to the basis effects that cost farmers and end users, a full accounting of the rail service challenges would also have to include the additional costs borne by grain handlers who could not optimally store the crops they bought or who could not physically ship and sell those crops when they chose. Also note that the USDA's calculations only included the three largest crops – corn, soybeans, and wheat – in four states that also produce significant quantities of specialty grains and grain and oilseed byproducts. Those other agricultural commodities ship by rail, too, so their segments of the industry also experienced reduced profits due to high freight costs. The ethanol industry, in particular, struggled as railroads failed to meet the pace of demand for ethanol tankers — and that was true for ethanol producers in all states. During the first week of December 2014, the average origin dwell time for ethanol trains throughout the United States was 35.8 hours, a 46 percent longer wait than ethanol producers experienced in October 2014, and 74 percent longer than the average for all types of train.

The calculated losses in farmer revenue, from above, are therefore just the lowermost limit of what the whole agriculture industry's overall estimated loss might be, if we could add those numbers together with the freight costs absorbed by the grain elevators themselves, the losses in other agricultural commodity markets, the losses borne by end users, and the losses that may have occurred in other geographical regions.

EFFECTS ON THE REGION AND THE INDUSTRY

EFFICIENCY

We've already investigated some of the costs to the agriculture industry that result from rail congestion and the industry's reliance on rail for shipping grain. Higher freight costs both eat into producers' revenues and drive up end user's input costs. Along the way, the elevators and resellers who merchandise grain absorb some of those freight costs but also incur economic damage from lost opportunities. Rail congestion causes increased downtime at elevators, sometimes making them unable to accept new grain and therefore unable to earn profit margins on additional turnover. Sometimes they accept the grain but must store it outside where it is susceptible to damage. These are all tangible examples of calculable economic losses.

Unfortunately, freight inefficiency may be causing additional, incalculable damage to the U.S. grain industry's reputation as the world's most cost-efficient and reliable provider of agricultural products. A 2014 study commissioned by the United States Soybean Export Council and the Soy Transportation Coalition found that soybean shipments from the United States tend to arrive at their destination within three days of their expected delivery date, compared to seven days for shipments from Argentina and 15 days for shipments from Brazil. That reliability encourages international customers to prefer U.S. grain. However, the same study also demonstrated the significance of rising U.S. freight costs in 2013 by examining the total transportation costs to move soybeans from origins in the U.S., Brazil, and Argentina to various Asian destinations. Off and on since 2009, southern Brazilian origins have enjoyed cheaper total transportation costs than Midwestern U.S. origins, but in the last two quarters of 2013, their price advantage grew.[14]

This emphasizes again why freight congestion is a matter of national importance to the grain industry. Direct costs may be most visible in the Upper Midwest region, but grain from any number of states gets comingled at an export facility and loaded all together into one ocean vessel. The reputation of the grain in that vessel as an efficient, reliable product critically depends on how well or how poorly the nation's freight system can expand its capacity.

THE CURRENT FREIGHT SCENARIO

The agriculture industry's dependence on efficient transportation cannot be overstated. Projections for 2015 from the U.S. Department of Transportation for freight flows between domestic origins and destinations suggest that 266.4 million tons of agricultural and food products will be moved across the country by a variety

FIGURE 12

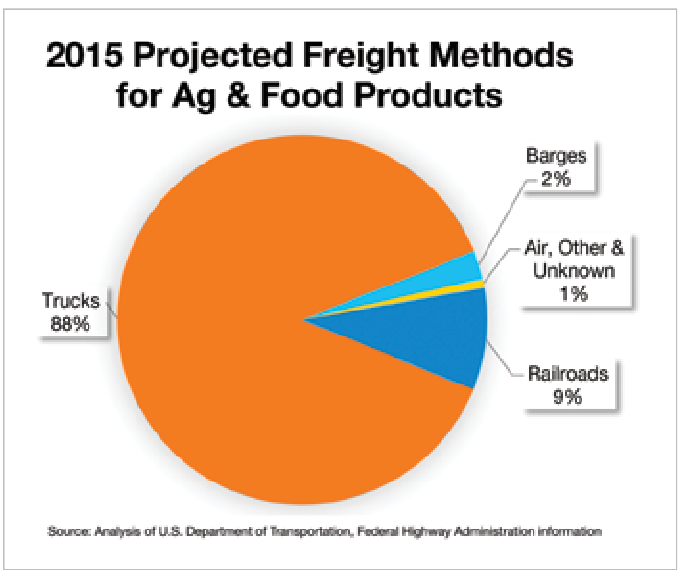


FIGURE 13

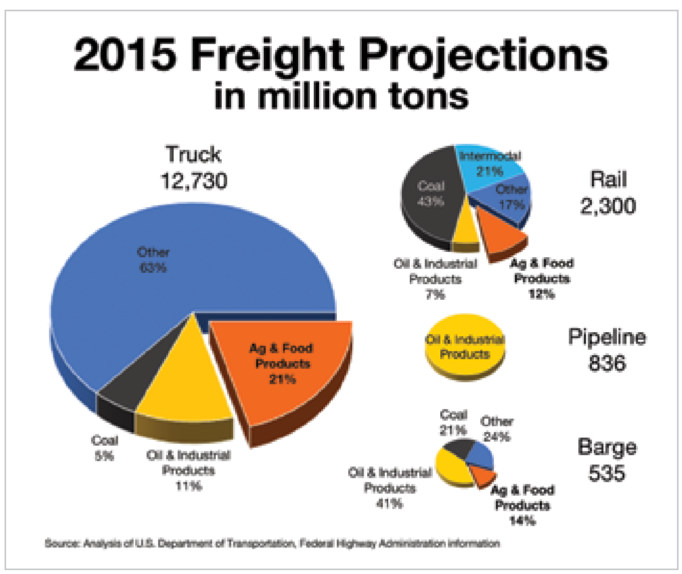
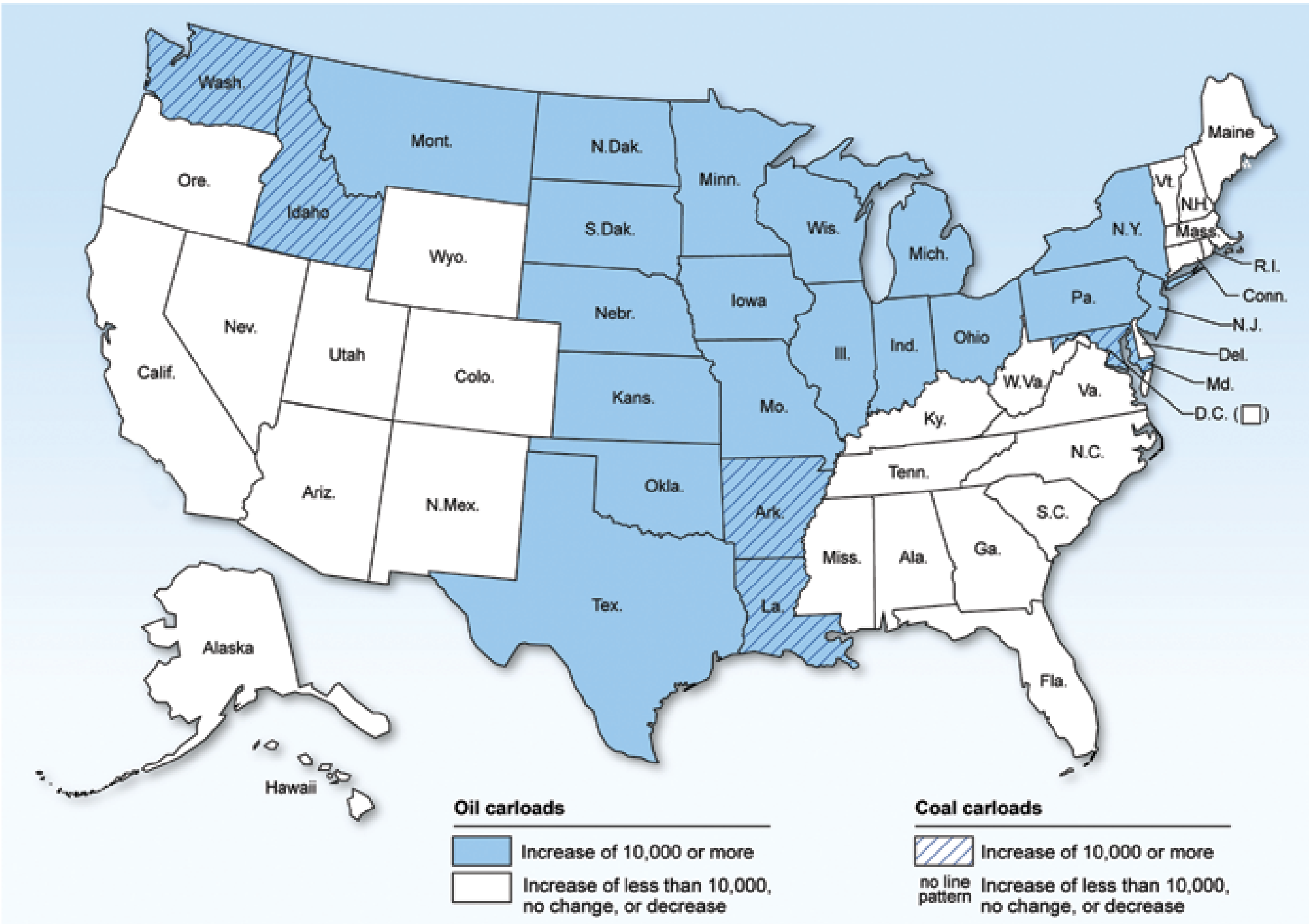


FIGURE 7

Estimated Change in Carloads of Crude Oil and Coal, by State 2007–2012



Source: GAO analysis of Surface Transportation Board data. | GAO-14-740

of methods. Cereal grain itself makes up about half of that volume, with other raw agricultural commodities — fruit, vegetables, livestock — also falling in this category alongside finished products for food and livestock feed (see Appendix I).

The vast majority of freight movement for ag and food products is done by truck, with 88 percent of the volume of 2015 projections. Railroads carry 9 percent of the category's volume, and barges 2 percent (see Figure 12).

Grain movement will always rely on trucks, simply by the nature of grain production, which takes place in broadly scattered fields that are frequently dozens of miles away from a rail access point. Shippers generally prefer to move grain in large shipments on long hauls by rail or barge because the economies of scale make those methods cheaper, but the trend in recent years has actually been moving increasingly toward truck freight. In 2006, 50 percent of total U.S. grain movements were made by truck. Five years later, trucks were moving more than 60 percent of grain, with railroads and barge shippers losing market share. Truck freight's growth is due to the increased number of grain processing facilities throughout the Corn Belt, particularly ethanol plants, which generally take in local grain brought on trucks.

Calculating these volumes can be an inexact science, though, with many shipments requiring more than one

FIGURE 8

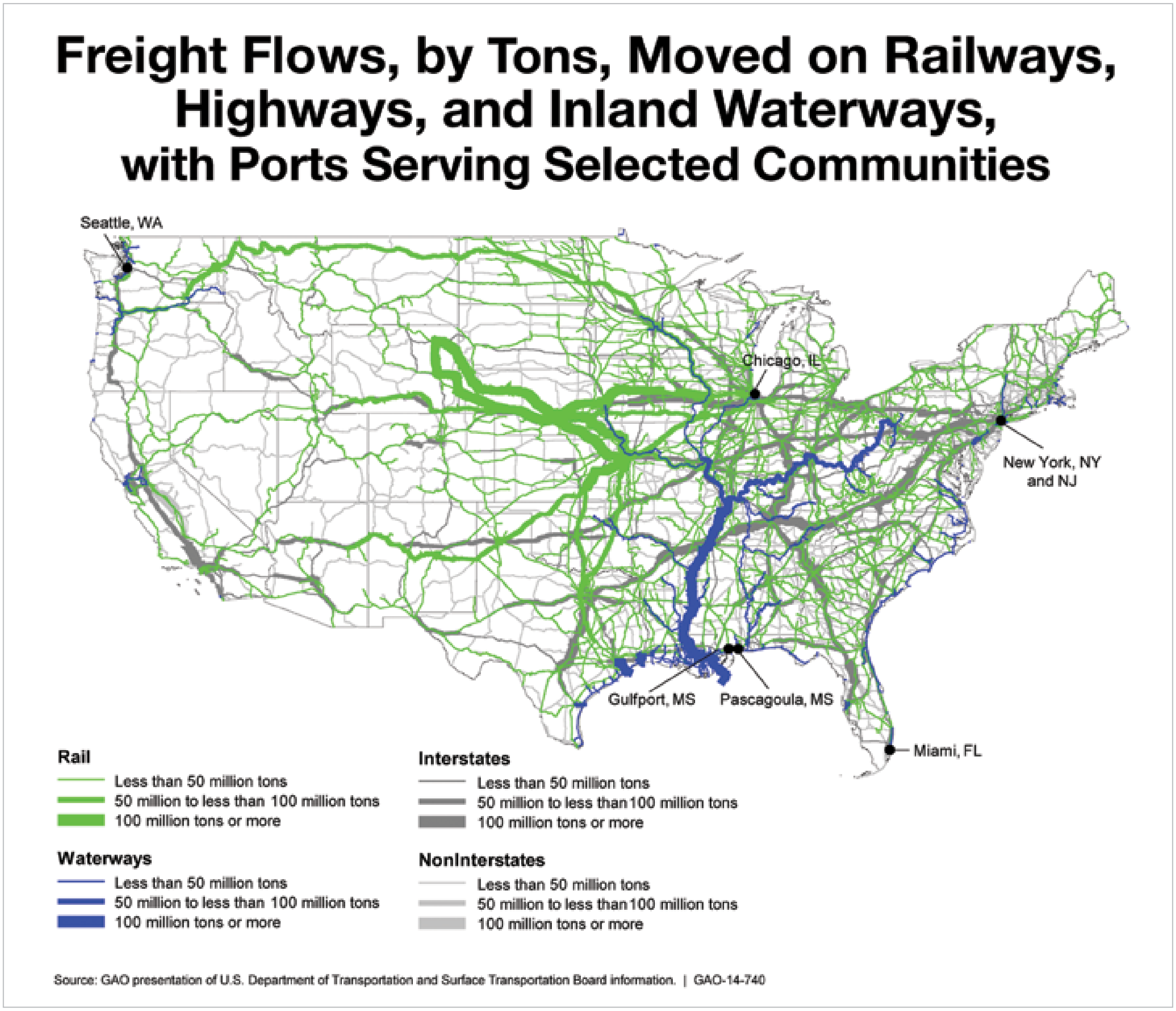
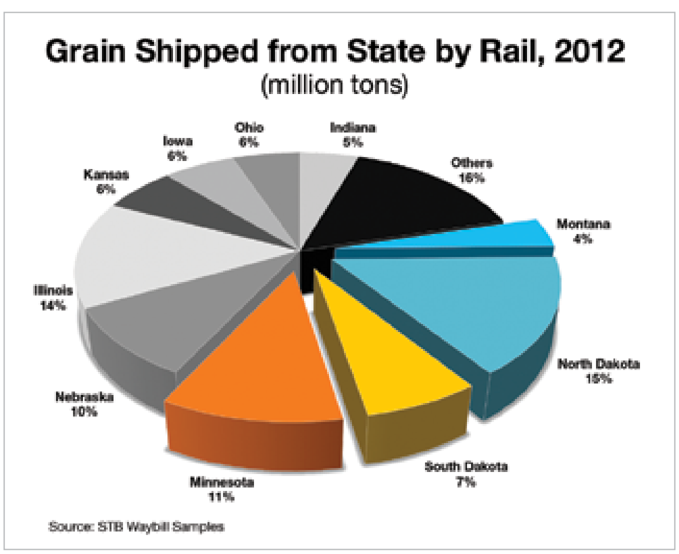


FIGURE 9



by barge may later need to be trucked to a poultry feeder, or dried distillers grains may need a truck haul from an ethanol plant to a container-loading facility, then that container itself may ship by rail, barge, or truck as “intermodal” traffic.

Agriculture takes up a significant share of almost all freight markets. The DOT’s 2015 projections for truck, rail, pipeline, and barge shipments again emphasize our reliance on trucks: 76 percent of all domestic freight flows move on trucks. Barges are expected to move only 3 percent of total tonnage in 2015. Railroads, meanwhile, are projected to carry 14 percent of U.S. freight. Their biggest customers are the coal industry (43 percent of rail traffic), intermodal/container shippers (21 percent), various other products, then the agriculture industry (12 percent of rail traffic), and finally oil and industrial products (7 percent). (See Figure 13).

Shipment of oil by pipeline already outpaces rail's volume of oil shipment: 836 million tons compared to 156 million tons (projected). More oil is projected to move even by barge, 221 million tons, than by rail (see Appendix I). And yet crude oil's relatively small portion of rail traffic is the most problematic for agriculture because of its safety concerns and because geographically, oil's rail routes directly pull resources, like locomotives, personnel, and track capacity, away from grain service.

HOW COMPETITION PROTECTED OTHER REGIONS

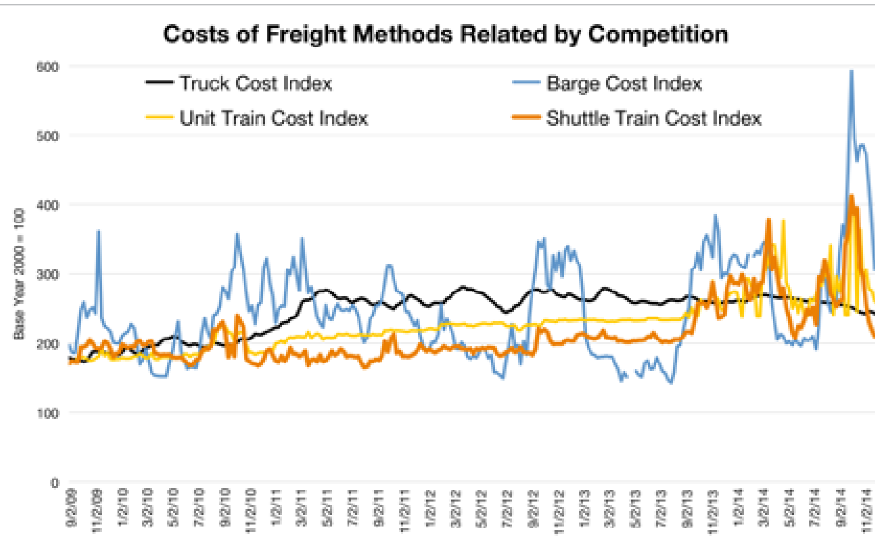
The relative basis losses seen in North Dakota and South Dakota since the 2013 harvest were uniquely bad, worse than what manifested in any other grain-producing region of the United States. The nationwide average corn basis level throughout the 2013-14 marketing year, collected daily by DTN from over 2,800 grain elevators, was 20 cents under the futures price. That's actually stronger than the nationwide average basis level from the benchmark "normal" 2009-10 marketing year: 37 cents under futures.

There are structural causes for the Dakotas' exceptional basis weakness, but as the nation's overall freight capacity continues to be overstrained, other regions should note these economic effects and view them as a warning for what might occur to their own agricultural revenue, if total freight capacity – not just railway capacity – continues to underserve the demand.

Rail congestion may be particularly bad in North Dakota, with additional traffic from Canadian and domestic crude oil shipments crowding the lines. The number of rail carloads of crude oil originated on major U.S. railroads is now 38 times higher (407,642 carloads in 2013) than it was as recently as 2009 (10,840 carloads).4 North Dakota is now the second biggest crude oil producing state, contributing more than 11.5 percent of U.S. oil.5 However, with the oil industry in this Bakken region being relatively less-developed than in other U.S. oil-producing states, this production contributed special strain on the state's rail and road infrastructure. North Dakota's oil production nearly tripled in the three years leading up to 2013, and yet the state still has fewer gathering pipelines and refineries than states with a more mature oil industry, like Texas.

Even though crude oil prices have fallen dramatically in late 2014, drilling and permitting activity did not immediately slow in North Dakota, according to the U.S. Energy Information Administration, and they still forecast U.S. oil production to continue rising in 2015. That oil, once it's loaded onto trains, doesn't just stay within North Dakota's or Texas' borders. In fact, the region where rail traffic of crude oil grew the most in the five years leading up to 2012 (see Figure 7) covers exactly the same states we think of as the "Corn Belt": Iowa, Illinois, Indiana, and eastward to the coast, as well as Nebraska, Kansas, and onward to the Gulf of Mexico. As rail congestion

FIGURE 10



Source: USDA Agricutural Marketing Service's weekly Grain Transport Cost Indicators. For Truck Index, includes diesel cost. For Rail Indices, includes near-month secondary rail market bid and monthly tariff rate with fuel surcharge. For Barge Index, includes Illinois River barge rate (percent of tariff rate).

continues to worsen, especially if the main driver of that congestion is additional crude oil traffic, major grain-producing states may eventually feel basis effects similar to North Dakota's recent experience.

However, many of those states have access to other shipping methods. Most American grain shippers choose to market loads of grain in one of roughly four directions: west by rail for export from the Pacific Northwest, south by rail or barge for export from the Gulf of Mexico, south by rail for livestock feeding in the U.S. or Mexico, or somewhere local by truck for domestic processing. Much of the Corn Belt has reasonable access to barge loading facilities (see Figure 8), so barge freight in these areas acts as competition to rail freight, meaning that if railcar costs get too high, those grain shippers could choose to send their grain in another direction and the railroads would lose business.

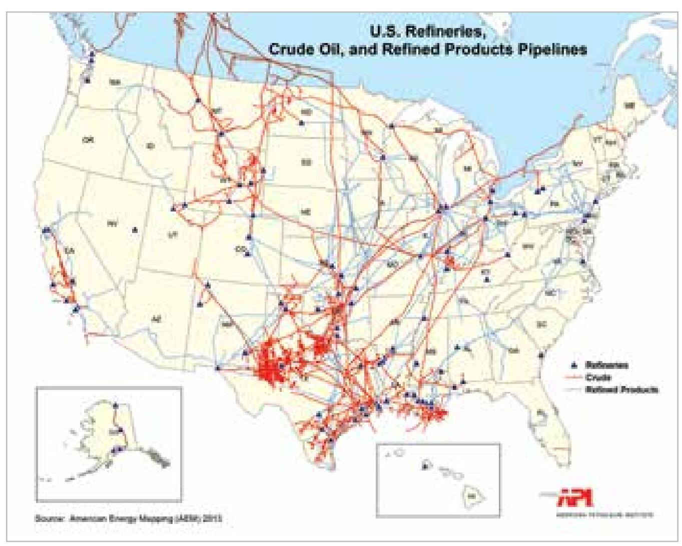
Grain shippers in Upper Midwest states – Minnesota, South Dakota, North Dakota, and Montana – have few or no reasonable alternatives to using railroads for shipping grain, and are therefore considered "captive shippers." It would take an extraordinarily strong bid for grain at the Gulf of Mexico, or extraordinary freight prices, for grain from the Upper Midwest to move in any direction but westward by rail. And rail is indeed the only reasonable method available -- trucking grain 1,400 miles from Fargo, North Dakota to a port in Seattle, Washington, for instance, would be cost prohibitive. That helps to explain why those grain elevators were forced to pay such expensive freight rates in early 2014, and why railroads didn't suffer a loss of demand for grain shipment in that environment. In 2012, for instance, because of their reliance on rail and lack of alternatives, Upper Midwest states shipped 37 percent of all grain that moved by rail (see Figure 9).

In the rest of the Corn Belt grain shippers have access to both rail and barge freight opportunities, a grain shipper's decision of which freight method to use is more complex than simply comparing the two shipping costs. There is a strong correlation between train costs and barge costs shows that the two products act as competitive substitutes, and in fact do so now more than ever. Comparing the weekly changes in the USDA's Grain Transport Cost Indicators (see Figure 10), the correlation between the Barge Index's weekly changes and the Shuttle Train Cost Index's weekly changes was 0.09 for the timeframe from 2002 to September 2013. After the rail congestion crisis hit, that relationship grew stronger – the correlation between the weekly changes of the two indexes has been 0.16. This timeframe of increasing rail demand and higher train costs has coincided with increasing barge demand and higher freight costs there, too. USDA data shows that more grain was shipped by barge in 2014 than in any year since 2010, and barge freight rates increased 54% over the previous year.

Truck freight, meanwhile, does not respond as strongly to the competing prices of other freight providers. America's roadways have also experienced a surge in commodity traffic and congestion in recent years. Many of the same factors that influence rail and barge costs – labor availability, fuel costs, infrastructure spending – also influence truck freight costs, but the routes for grain served by truck freight are unlike those served by rail and barge freight. Truck hauls tend to be shorter, primarily serving the market for local processing of wheat, soybeans, and corn (especially for ethanol).

In every scenario involving the combined use of every type of freight available, there needs to be national concern about increasing America's overall freight capacity, which will ease the congestion and costs borne by grain shippers. However, the grain industry's focus naturally lies on rail freight specifically, which serves more regions than barge freight and provides the long-haul services that are most necessary to efficient grain distribution. Any alternative that seeks to ease the congestion of our freight system must be evaluated by asking whether it is an improvement on the safety, community effects, and efficiency of the status quo reliance on rail freight.

FIGURE 15



ALTERNATIVES

Each method of freight presents its own challenges, especially in the context of optimizing the nation's overall freight efficiency to prevent damages to the grain industry.

■ *Truck Freight Challenges*

Although truck transport is wonderfully flexible and in some cases the only reasonable option (let's say you need to haul cattle from a remote feedlot on a gravel road to a packing plant in the middle of a busy city), it is definitely the most expensive. Moving oil, for instance, by truck from North Dakota to the Gulf of Mexico might cost $20 per barrel in 2014.[15] In some regions, particularly at cities and near port facilities, there are sometimes shortages of trucks or of available truck drivers, which can drive up costs and trigger delays and inefficiency.

■ *Rail Freight Challenges*

Rail is also a flexible freight method, able to haul most substances across routes that span the continent. For long hauls, it is less expensive than shipping by truck. That same oil moving from North Dakota to the Gulf of Mexico would only cost $10 to $15 per barrel if hauled by rail.

■ *Barge Freight Challenges*

Compared to truck or rail access, navigable rivers just don't have the geographical reach or flexibility. We can't even give a perfectly parallel cost comparison for hauling oil from North Dakota to the Gulf of Mexico, for instance, because there are no barge loading facilities in North Dakota. In mid-2014, barge freight was about $30 per ton from the northernmost Mississippi River access point to the Gulf (equivalent to $4.50 per barrel of oil), so without accounting for the initial leg that would haul the oil to that point, barge shipping is one of the very most economical freight methods. Its major drawback, however, is its limited overall capacity, which gets limited further by seasonal shutdowns.

TABLE 1

PROPOSED / NEW U.S. PIPELINES AND CAPACITIES

NAME	CAPACITY	ROUTE	NOTES
Alberta Clipper	800,000 barrels per day	From Canada through North Dakota at Gretna Border Crossing to Superior, Wisconsin	New Border Segment will connect with existing Line 3 to bring crude over the border, then re-connect with the Clipper.
Dakota Access	570,000 bpd	From North Dakota through Iowa to Illinois	Holding hearings, expecting state-level permits in 2015, construction in 2016.
Sandpiper	375,000 bpd	From North Dakota through Minnesota to Wisconsin	Expecting approval from Minnesota's PUC in June 2015.
Upland	300,000 bpd	From North Dakota to a pipeline connection in Saskatchewan	Subject to State Dept. approval, expected to be in service 2018.
Double H	84,000 bpd	From North Dakota to Wyoming	Went into service 1st quarter 2015.
Global Stampede	50,000 bpd	46 miles long from Divide and Burke Counties in ND to a rail facility	Application submitted, public hearings being held.
Freedom	200,000 bpd	From Texas to California	Shelved in 2013, now re-exploring refiners' interest. Must cross the Rocky Mountains.
Saddle Butte	50,000 bpd	Gathering from the San Juan Basin through New Mexico	Needs BLM, state, tribal, and private approvals.
Keystone XL	*830,000 bpd*	*From Canada and North Dakota to Oklahoma and Texas*	*Would cross U.S. border, denied presidential approval since September 2008.*
Enterprise	*340,000 bpd*	*From North Dakota to Cushing, Oklahoma*	*Project shelved in late 2014 due to low oil prices.*

TABLE 2

SHUTTLE EQUIVALENT UNITS	OIL & INDUSTRIAL PRODUCTS	AG & FOOD PRODUCTS	COAL	OTHER	INTERMODAL
Rail	14,492	25,371	63,369	56,408	120,852
Truck	132,137	248,126	41,221	1,133,383	
Barge	20,466	7,158	6,985	18,042	
Air, Other & Unknown	1,644	2,066	7,578	18,110	
Pipeline	77,379				

■ *Air Freight Challenges*

Air freight, even when grouped together with 'Other' and 'Unknown' freight methods in the Department of Transportation's 2015 flow projections, represents a negligible portion (22 million tons) of the overall national freight scenario. It's likely the most expensive way to get a commodity shipment from one location to another. However, because air cargo carriers can transport intermodal traffic and free up capacity from other freight methods, it belongs in this overall analysis.

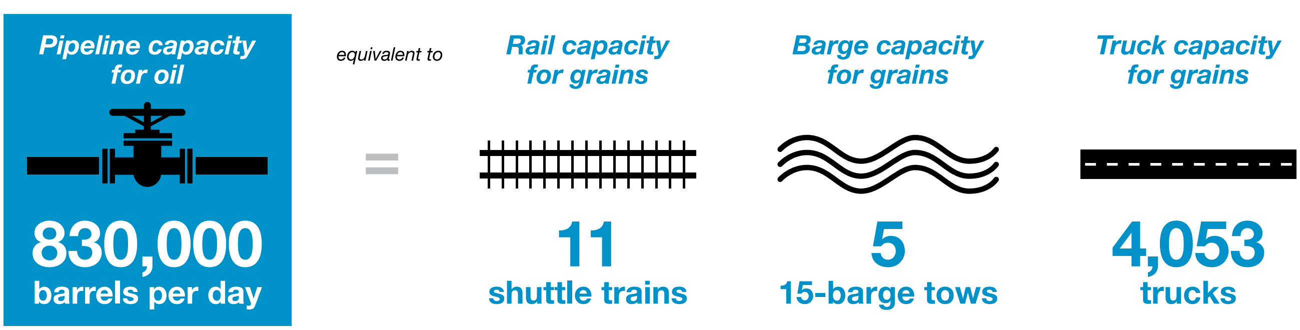
■ *Pipeline Challenges*

The cost of shipping oil from North Dakota to the Gulf of Mexico through a pipeline in 2014 was about $5 per barrel, so it is no wonder that oil shippers send as much volume as they can through pipelines (836 million tons projected in 2015), and only use rail (157 million tons) and barge freight (221 million tons) as overflow, or to reach destinations not served by pipelines. As a freight alternative, pipelines are certainly economically favored, but are also more efficient than above-ground freight methods because they have no weather-related delays, or congestion caused by multiple categories of commodities all trying to crowd through one route. If grain shippers or lumber shippers or scrap metal shippers were physically able to send their products through a pipeline, they would be delighted to do so.

Pipeline freight's imperfections come from its limited number of access points (see Figure 15) and its environmental risks. Oil spills from pipelines, although growing smaller and less frequent as regulations and technological monitoring improves, earn serious public scrutiny because such spills may go undetected underground in a remote location and damage ecologically-sensitive areas. In competition with truck or rail shipment, however, pipelines are widely considered the safest, cheapest, and most efficient method for transporting oil and industrial liquids.

FIGURE 16

Examples of Grain-Hauling Capacity Freed by Proposed Pipeline Construction



Capacity of the proposed Keystone XL pipeline

Assume 3,500 bushels of grain per hopper car in 100-car shuttles. 52,500 bushels per barge in 15-barge tows. 950 bushels per truck.

COMPETITION BETWEEN FREIGHT METHODS

Commodities *will* move where they're wanted, one way or another. In this way, competition urges efficient service from freight providers. We have already explored in this paper how the prices of one freight method, like rail, affect the prices of other competing methods, like barge shipping.

So oil from Canada and North Dakota *will* make its way to the international market, one way or another. It may travel a) to refineries and exporters through a potentially expanded U.S. pipeline infrastructure, or b) south to the Gulf of Mexico through existing pipelines, or c) south to the Gulf of Mexico via above-ground, more expensive, more dangerous methods (truck, rail, and barge), or d) west and east to other demand points, primarily by rail, or e) some combination of all of the above. Competition by cost, convenience, and service level will determine which routes will be taken — the ones that expand the nation's overall freight resiliency, or the ones that strain it even further.

Analysis of pipeline capacity may not seem like a necessary part of substantiating the recent freight challenges faced by the agriculture industry. After all, not even ethanol, an agricultural byproduct, moves through oil pipelines (it's too corrosive). Natural gas, a common input for grain handling, is shipped through its own pipeline infrastructure that cannot substitute for or compete with the oil pipeline infrastructure without retrofitting. Coal technically can be slurried and shipped through oil pipelines, but this is not presently done in the United States and it's not an agricultural product, anyway.

Nevertheless, the agriculture industry will be affected as all freight methods compete with each other to expand capacity in future years. *Any additional volumes of oil that pipelines can carry will represent less freight volume putting strain on the nation's rail, barge, and truck systems.* However, the expansion of the nation's pipeline capacity requires significant capital expenditure that isn't flexible to future changes in demand, and each potential pipeline project has a lead time of two years or more.

POTENTIAL FREIGHT SCENARIOS

Multiple significant pipeline projects are being proposed to expand the oil-carrying capacity of the nation's freight system, although progress on some of them has been deferred due to low oil prices in early 2015 or pending political approval for routes that cross national borders. For a list of some of these projects, see Table 1.

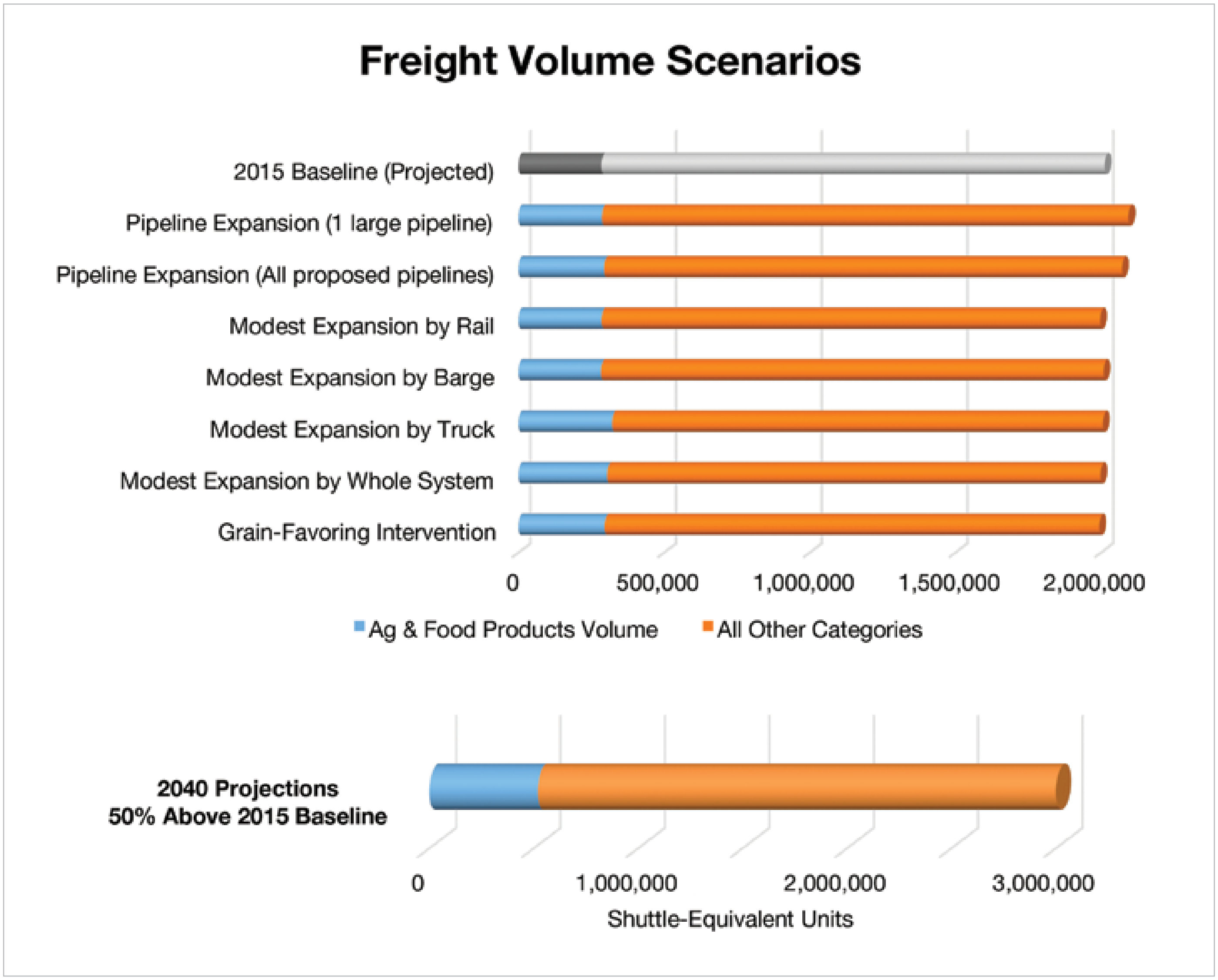
These proposals would take some of America's crude oil production off the rail routes and carry it more safely and cheaply by pipeline instead. Crucially, this expansion of the nation's pipeline infrastructure is currently focused on the Upper Midwest, which has so far borne the brunt of higher freight costs to its agriculture sector and which now stands to benefit most from increased freight capacity. For instance, the Dakota Access pipeline is slated to move 450,000 barrels per day, roughly 1/3 of the Bakken formation's output. If this and all other proposed pipelines were to be built, the nation's oil pipeline transportation capacity would increase by 2,629,000 barrels per day, or approximately 144 million tons per year. That would represent a 17 percent increase in the originally projected tonnage of oil shipped by pipeline in 2015.

Pipelines take time to acquire permits and additional time to build, so there is no way all of this extra oil-hauling capacity will be part of the overall freight system by 2015. Nevertheless, we can investigate how capacity expansion from every method of freight would theoretically affect overall freight resilience, and especially how it might affect the transport of agricultural commodities.

A model of simulated scenarios for future freight volumes investigates how the national freight system would respond to carry the maximum volume for each simulated set of capacities (see Appendix II). The baseline scenario presents no change to the U.S. Department of Transportation's 2015 projections for five categories of commodities to be carried by five methods of freight service (see Table 2).

Note that the volumes used in this model are not total tonnage, but rather simulated individual shipments. For rail freight, the number of shipments, given as "shuttle equivalent units," is equal to the total projected tonnage divided by the number of tons per shuttle of each category of freight (e.g. oil shuttles carry 10,800 tons each). In order to compare the five freight methods in

FIGURE 17



an apples-to-apples context, each method's projected tonnage was also converted to "shuttle equivalent units." This represents logistic reality — freight carriers must try to maximize the number of transactions they provide each year, and a 4,000-ton unit of intermodal traffic may take up essentially as much time, space, equipment, and crew as a 15,800-ton coal shuttle.

Also note that intermodal traffic, which by definition travels via more than one freight method, is only counted once, as rail traffic. This avoids doubling some flow data, and still captures the influence of container shipping on rail congestion.

The following scenarios were explored:

- ***Baseline 2015 DOT Projections***

- ***Pipeline Expansion***

If one very large proposed pipeline were to be built and add capacity to the nation's freight system, 830,000 barrels per day of oil would be re-routed away from other freight methods. On the railroads, for instance, that quantity of oil could be carried by 11 shuttle trains per day or roughly 4,000 shuttle trains per year (see Figure 16). If all the proposed pipelines were built, that would free up freight capacity equivalent to 12,000 shuttle trains per year. This scenario (Scenario 1 in Appendix II) assumes that all other freight methods' capacities remain constant and examines what effects would arise from additional pipeline capacity. Does the overall volume of grain shipped increase?

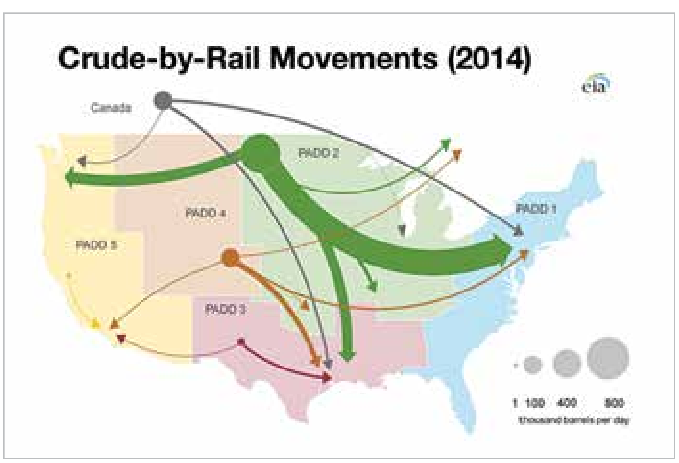
■ ***Modest Expansion by Other Freight Methods***

Increasing the capacity of America's oil pipelines by 830,000 barrels per day would be approximately a 5 percent expansion. Meanwhile, fuel tax increases are being used for reconstruction of the nation's barge shipping infrastructure, and major railroads are investing in improvements to their capacity — the BNSF is planning to spend $6 billion on expansion in 2015 and the UP has slotted $4.1 billion toward that same purpose. These investments can only modestly increase the freight system's capacity, and other forces may simultaneously throttle growth. It can take up to a year to add equipment and personnel to railroads, and within two years, the DOT will impose rules for slower speeds on the railroads.[17] This scenario (Scenarios 2, 3, and 4 in Appendix II) explores the results when other freight methods are individually expanded by a modest degree — the same 5 percent proportion represented in the pipeline expansion scenario. Which freight method on its own most benefits from expansion, leading to a more resilient national freight system and increasing the capacity for shipping grains?

■ ***Pipeline-Equivalent Expansion by Other Freight Methods***

This scenario (Scenarios 5, 6, and 7 in Appendix II) explores the results when other individual freight methods are expanded by the same absolute value of shuttle equivalent units as carried by just one very large pipeline. Which freight method offers the most benefits from this tweak?

FIGURE 18



■ ***Modest Expansion by the Whole System***

If investment could be made to all U.S. freight systems to expand their capacities equally by 5 percent, which categories of commodities would benefit the most from this modest expansion? (Scenario 9 in Appendix II) Are agricultural commodities well suited to take advantage of broad infrastructure investment, or would they be better off by focusing on specific freight methods?

■ ***Aggressive Expansion by Whole System***

Looking past 2015, the DOT projects U.S. overall freight volumes will rise 12 percent by 2020, 27 percent by 2030, and 45 percent by 2040, when the system will need to handle 28.5 billion tons of freight.[18] This scenario (Scenario 10 in Appendix II) examines how each category of commodity benefits as the freight providers theoretically expand their capacities by 50 percent. Where will the sticking points be as we proceed into the future?

PREDICTED EFFECTS ON CONGESTION

It's difficult to say whether a 1 percent increase in the capacity and volume of grain shipments by rail, for instance, would be enough to eliminate the backlogs experienced by grain shippers during recent harvest timeframes. Nor do we know what quantity of overall transportation capacity would be necessary to bring rail freight costs down for captive shippers of grain in the Upper Midwest. But through modelling the scenarios above, we can draw conclusions about which adjustments to the nation's freight system would have the most theoretical impact on the agriculture industry.

In every proposed scenario that expanded capacity of either one freight method or multiple freight methods, the overall volume of grain that could be shipped was increased. Adding 4,000 shuttle equivalent units of annual capacity to the nation's pipeline system did indeed free up capacity on the railroads, which they could then utilize for grain shipments. This was also true when the pipeline capacity was increased by 12,000 shuttle equivalent units.

Adding the same absolute quantity of capacity (4,000 shuttle equivalent units) to other freight systems' capacities made only subtle changes to the volume of ag and food products that could be shipped. Without extra pipeline capacity to specifically pull crude oil traffic out of the rest of the system, the model tended to route extra capacity equally among all the categories of commodities. Getting an extra 1,000 shuttles of ag products hauled per year is a negligible result in the broad scheme of things.

Scenarios that could allow other freight methods to expand by that same modest degree, 5 percent, made it very clear which individual methods are most influential to the nation's overall freight system. Allowing the nation's truck capacity to expand by 5 percent resulted in a 4 percent increase in overall volume, but a 14 percent increase in the volume of ag and food products that could be hauled. Meanwhile, encouraging rail capacity to expand by 5 percent would mostly benefit the coal and intermodal volumes (up 2 percent) and ag products only to a smaller degree (1 percent).

Perhaps because of their reliance on being hauled by trucks, which make up the largest portion in any theoretical scenario, agricultural commodities are particularly well-suited to take advantage of broad infrastructure investment. If all the U.S. freight methods were to evenly gain 5 percent more capacity, ag shipping volumes could rise 8 percent. Truck shipping capacity appears to be the factor on which maximizing ag commodity movement depends, even though it the most expensive and most challenging to communities and the environment. It's therefore imperative to ensure that whichever commodities can be sent via safer, cheaper freight methods are sent via those methods, e.g. oil through pipelines.

Therefore, we see that changing grain freight flows isn't the key to fixing the nation's congestion. Grain must move by truck for certain routes and it will inevitably require rail transport for longer routes. *Opportunities for system-wide improvement must come from other commodities, specifically from oil and industrial products, which can be channeled off the truck / rail / barge system entirely and moved into pipelines for certain routes. These are the only commodities capable of being moved by this cheaper, safer form of transportation, and pipelines are the one form of transportation that is best suited to expansion in the United States without crowding already overstressed rail terminals and highways.*

These simulated scenarios were necessarily simplified in order to make it possible to calculate system-wide and industry-wide results, but they are therefore too simplified to fully model the potential regional and local effects — backlogs, delays, costs — that will undoubtedly arise as the nation's freight system undertakes the messy process of expanding to meet growing demand. In reality, there is no theoretical amount of expansion from just one freight system that would ever fully meet future demand. An infinite amount of rail capacity for grain hauling would never eliminate the industry's reliance on trucks to haul grain short distances to local processing plants or other freight access points. Similarly, infinite construction of new pipelines would never fully remove the geographically-dispersed demand for crude oil that will keep it shipping on certain truck and rail routes no matter what. See Figure 18 for the rail routes that crude oil travelled most heavily in 2014, some of which clearly overlap proposed pipeline routes, and some of which may continue to be reliant on rail long-term.

Nevertheless, from a cost perspective, any additional source of capacity for any commodity can theoretically make the nation's overall freight system more resilient and less prone to volatile freight charges for other commodities. Therefore, a focus on expanding the safest, cheapest forms of oil transportation, for instance, is subsequently expected to make agricultural transportation more efficient, too.

CONCLUSION

Agriculture's sole purpose has always been and always will be to produce safe, affordable and abundant food, feed, fiber and fuel, to consumers who may be located very far away from the fields in which they're grown. Efficient transportation is as crucial to a farmer's business as highly-productive seed, and it's as crucial today as it has ever been. No amount of internet technology or biotechnology will ever engineer away the need for large volumes of dry grain to be comingled and moved over long distances.

That being said, some freight strategies are better than others – safer or more flexible or less harmful to the environment – and some freight methods are simply unavoidable. By sheer volume, truck freight is the biggest piece of the grain transportation puzzle, as shown in this paper's simulation. But that's not the piece that most harms the agriculture industry's profitability when the nation's freight infrastructure becomes congested. Rather, rail freight holds that distinction. When rail is the only reasonable transportation solution for farmers in certain regions, like the Upper Midwest, rail service providers have the agriculture industry at their mercy and insufficient service threatens the industry's ability to operate.

It's therefore imperative for the agriculture industry to encourage infrastructure projects that take congested freight volume off of the rail lines and add that capacity to the overall system. There are many alternatives on the horizon – expanding highway capacity, rail capacity, barge capacity. The scenarios explored in this paper suggested that certainly any or all of these alternatives might increase the capacity available to haul agricultural commodities and might reduce the effects of congestion. But there may be consequences to these scenarios that the agriculture industry would want to avoid. Truck and rail infrastructures are notoriously difficult and expensive to expand, particularly at urban transportation hubs, and hauling commodities by these methods is expensive.

Expansion of U.S. pipeline capacity, therefore, represents the best alternative to add overall freight system capacity and relieve the congestion that has threatened grain movement during recent marketing years. Crude oil and fuels can be moved cheaply through pipelines without disrupting already-crowded freight hubs, without congesting traffic in communities, and without even altering the landscape or agricultural use of the land where the pipeline passes. Today's pipeline technology and stringent regulation environment minimizes the potential environmental effects of leaks and spills.

Most of the presently proposed pipeline projects are being designed to haul crude oil out of North Dakota, an especially significant geographical hotspot where the grain industry has been hurt by insufficient rail service. It's tempting to wonder: how much pipeline expansion would it take to bring rail freight costs back down from the lingering high levels that have cost each farmer in the Upper Midwest thousands of dollars of lost revenue in the past and present marketing years? Unfortunately, the theoretical freight price response is unpredictable. Some crude oil from North Dakota must always travel by rail to destinations that are unreachable by pipeline, and even if the costs of shipping oil by pipeline remain significantly cheaper than shipping oil by rail, the supply and demand for the railroad's locomotive service and grain hopper cars will influence grain freight prices independently of crude oil volumes. There is no guarantee that expanding the capacity of any freight method — pipelines, rail, truck, or barge — would automatically bring down grain freight prices.

Fortunately, changing the U.S. transportation infrastructure will create impacts felt beyond freight costs and arguably more important than freight costs — it's hard to put a price on the efficient operation of our modern transportation system and the marketing opportunities it provides for the U.S. grain industry.

APPENDIX I

2015 FREIGHT PROJECTIONS BY CATEGORY AND METHOD (IN TONS)

Federal Highway Administration, U.S. Department of Transportation

2015 Projections: Domestic Flows Between Domestic Origins and Destinations

Ag & Food Products

Volume moved by RAIL

Cereal grains	188,840,875
Other foodstuffs	29,313,451
Animal feed	23,443,779
Other ag prods.	16,551,529
Milled grain prods.	8,249,976
	266,399,611

Volume moved by BARGE

Cereal grains	56,524,577
Other foodstuffs	1,246,809
Animal feed	256,010
Other ag prods.	17,085,849
Milled grain prods.	50,562
	75,163,807

Volume moved by TRUCK

Cereal grains	1,322,984,141
Other foodstuffs	511,041,257
Animal feed	248,078,633
Other ag prods.	396,608,849
Milled grain prods.	126,606,051
	2,605,318,931

Oil & Industrial Products

Volume moved by RAIL

Basic chemicals	95,590,927
Fertilizers	41,712,522
Chemical prods.	7,419,386
Gasoline	6,771,532
Fuel oils	4,365,303
Crude petroleum	651,613
	156,511,283

Volume moved by BARGE

Basic chemicals	46,409,097
Fertilizers	4,523,466
Chemical prods.	848,575
Gasoline	40,625,472
Fuel oils	86,412,864
Crude petroleum	42,212,954
	221,032,428

Volume moved by TRUCK

Basic chemicals	193,309,711
Fertilizers	137,700,056
Chemical prods.	119,622,607
Gasoline	590,109,516
Fuel oils	376,020,945
Crude petroleum	10,316,840
	1,427,079,675

Coal

Volume moved by RAIL

Coal	928,063,843
Coal-n.e.c.	73,171,156
	1,001,234,998

Volume moved by BARGE

Coal	46,241,422
Coal-n.e.c.	64,124,197
	110,365,619

Volume moved by TRUCK

Coal	226,460,422
Coal-n.e.c.	424,834,892
	651,295,314

Other

Volume moved by RAIL

Live animals/fish	17,593
Alcoholic beverages	9,409,998
Building stone	20,636
Natural sands	12,975,305
Gravel	81,711,066
Nonmetallic minerals	25,329,810
Metallic ores	57,852,546
Plastics/rubber	36,752,401
Logs	3,149,005
Wood prods.	16,510,118
Newsprint/paper	25,484,722
Paper articles	1,019,950
Printed prods.	268,582
Textiles/leather	912,569
Nonmetal min. prods.	22,600,049
Base metals	52,087,766
Articles-base metal	8,543,302
Machinery	601,548
Electronics	375,299
Motorized vehicles	7,304,696
Transport equip.	1,729,943
Furniture	62,578
Misc. mfg. prods.	644,498
Waste/scrap	33,977,431
Mixed freight	1,071,747
Unknown	82,958
	400,496,114

Volume moved by BARGE

Alcoholic beverages	926,005
Tobacco prods.	42
Building stone	4,935
Natural sands	4,221,177
Gravel	77,722,788
Nonmetallic minerals	18,703,407
Metallic ores	3,126,348
Pharmaceuticals	19
Plastics/rubber	68,067
Wood prods.	205,501
Newsprint/paper	116,443
Paper articles	249,348
Printed prods.	456
Textiles/leather	21,593
Nonmetal min. prods.	15,396,728
Base metals	3,716,294
Articles-base metal	102,498
Machinery	12,096
Electronics	455
Motorized vehicles	22,934
Transport equip.	508,013
Precision instruments	169
Furniture	196
Misc. mfg. prods.	7,684
Waste/scrap	2,846,494
Mixed freight	115,302
	128,094,992

Volume moved by TRUCK

Gravel	1,627,074,417
Nonmetal min. prods.	1,250,332,640
Waste/scrap	1,198,134,137
Logs	598,661,754
Natural sands	429,880,167
Wood prods.	386,156,867
Mixed freight	350,975,069
Base metals	347,509,333
Nonmetallic minerals	199,996,270
Articles-base metal	194,673,421
Unknown	191,546,242
Machinery	188,403,179
Motorized vehicles	158,692,591
Plastics/rubber	143,647,312
Alcoholic beverages	129,212,352
Misc. mfg. prods.	116,512,427
Live animals/fish	111,014,407
Newsprint/paper	94,200,267
Paper articles	79,126,533
Electronics	55,028,049
Textiles/leather	51,848,580
Building stone	43,326,497
Printed prods.	33,502,570
Furniture	27,925,666
Pharmaceuticals	15,339,888
Metallic ores	7,787,038
Transport equip.	6,947,929
Precision instruments	6,715,488
Tobacco prods.	2,845,934
	8,047,017,026

Intermodal

Cereal grains	12,641,354
Other ag prods.	14,312,445
Animal feed	13,018,456
Milled grain prods.	5,488,087
Other foodstuffs	12,413,003
	57,873,344
Crude petroleum	0
Gasoline	18,423,631
Fuel oils	44,032,589
Basic chemicals	11,975,007
Fertilizers	11,296,555
	85,727,781
Coal	47,518,675
Coal-n.e.c.	20,172,246
	67,690,922
Live animals/fish	11,892
Alcoholic beverages	4,544,097
Tobacco prods.	56,256
Building stone	124,100
Natural sands	11,300,894
Gravel	71,564,616
Nonmetallic minerals	8,528,557
Metallic ores	29,248,570
Pharmaceuticals	1,822,501
Plastics/rubber	12,246,195
Logs	2,571,642
Wood prods.	10,592,534
Newsprint/paper	16,231,884
Paper articles	2,239,640
Printed prods.	1,967,810
Textiles/leather	4,246,271
Nonmetal min. prods.	14,933,859
Base metals	25,034,549
Articles-base metal	5,610,846
Machinery	4,112,343
Electronics	4,611,028
Motorized vehicles	7,974,172
Transport equip.	596,646
Precision instruments	2,177,532
Furniture	941,739
Misc. mfg. prods.	6,436,097
Waste/scrap	11,691,158
Mixed freight	4,377,592
Unknown	38,543
	265,833,564

APPENDIX I (CONTINUED)

Volume moved by AIR

Other foodstuffs	78,737
Animal feed	641
Other ag prods.	121,606
Milled grain prods.	11,335
	212,319

OTHER & UNKNOWN

Cereal grains	5,557,164
Other foodstuffs	6,934,511
Animal feed	3,330,396
Other ag prods.	2,968,849
Milled grain prods.	2,686,490
	21,477,410

Volume moved by AIR

Basic chemicals	8,451
Fertilizers	1,536
Chemical prods.	168,817
Gasoline	104,061
Fuel oils	126,113
	408,978

OTHER & UNKNOWN

Basic chemicals	2,706,630
Fertilizers	3,498,493
Chemical prods.	1,596,589
Gasoline	1,882,092
Fuel oils	2,245,559
	7,801,712

Volume moved by PIPELINE

Basic chemicals	48,134,887
Chemical prods.	715,920
Gasoline	336,552,675
Fuel oils	188,304,063
Crude petroleum	261,980,974
	835,688,518

Volume moved by AIR

Coal-n.e.c.	6,519
	6,519

OTHER & UNKNOWN

Coal	97,158,323
Coal-n.e.c.	22,572,446
	119,730,769

Volume moved by AIR

Live animals/fish	12,002
Alcoholic beverages	20,150
Tobacco prods.	251
Natural sands	4,653
Nonmetallic minerals	87,314
Metallic ores	0
Pharmaceuticals	91,225
Plastics/rubber	105,061
Wood prods.	33,858
Newsprint/paper	7,723
Paper articles	8,866
Printed prods.	57,491
Textiles/leather	87,344
Nonmetal min. prods.	91,724
Base metals	43,882
Articles-base metal	63,217
Machinery	207,135
Electronics	374,207
Motorized vehicles	164,833
Transport equip.	141,633
Precision instruments	219,070
Furniture	6,555
Misc. mfg. prods.	295,893
Mixed freight	88,874
Unknown	836
	2,213,799

OTHER & UNKNOWN

Live animals/fish	58,117
Alcoholic beverages	497,913
Tobacco prods.	6,146
Building stone	1,516,769
Natural sands	16,509,243
Gravel	30,385,963
Nonmetallic minerals	8,980,376
Metallic ores	47,592
Pharmaceuticals	1,514,983
Plastics/rubber	4,029,453
Logs	205,484
Wood prods.	4,121,306
Newsprint/paper	1,136,749
Paper articles	797,447
Printed prods.	1,680,032
Textiles/leather	1,013,275
Nonmetal min. prods.	16,912,029
Base metals	3,816,751
Articles-base metal	1,906,850
Machinery	2,210,300
Electronics	2,901,735
Motorized vehicles	13,718,929
Transport equip.	183,922
Precision instruments	435,834
Furniture	565,280
Misc. mfg. prods.	5,898,776
Waste/scrap	2,525,265
Mixed freight	2,730,030
Unknown	58,023
	126,364,575

Source: Analysis of data from Freight Analysis Framework Data Tabulation Tool. Bureau of Transportation Statistics, Federal Highway Administration, U.S. Department of Transportation.

APPENDIX II

SIMULATED SCENARIOS FOR FUTURE FREIGHT VOLUMES

MODEL DESIGN (CONSTRAINTS):

* The model optimizes distribution of five categories of commodities carried by five methods of freight service.
* In each scenario, the categories' total volume must at least match the Department of Transportation's original 2015 projections ("MIN SHIPMENTS")
* Volumes are listed in "shuttle equivalent" units rather than tons, to represent logistic reality (some categories can fit more tons per unit of freight).
* Due to freight providers' obligations as common carriers, the model does not take varying freight revenues from different categories into account.
* Pipeline capacity only serves one category of commodity (oil).
* Natural gas pipeline capacity is disregarded, as it does not compete with other commodity freight opportunities.
* All intermodal volume is only counted in one method (rail).
* The model maximizes a scenario's total number of shuttle equivalent units, simulating freight providers maximizing their number of freight transactions.
* For each scenario, the maximum capacity of each freight method is constrained at either the present 2015 projections, or set at an experimental level.

BASELINE SCENARIO: **Estimated '15 100% Utilization -- Optimized Distribution**

	Ag & Food Products	Oil & Industrial Products	Coal	Intermodal	Other	TOTAL	MAX CAPACITY
Rail	25,371	14,492	63,369	120,852	56,408	280,492	294,517
Pipeline	-	77,379	-	-	-	77,379	81,379
Barge	7,158	20,466	6,985	-	18,042	52,651	52,651
Truck	248,126	132,137	41,221	-	1,133,383	1,554,867	1,554,867
Air, Other & Unknown	2,066	1,644	7,578	-	18,110	29,398	29,398
TOTAL	282,721	246,117	119,154	120,852	1,225,942	1,994,786	
MIN SHIPMENTS	282,720	246,117	119,153	120,851	1,225,942		

COMPARISON TO ORIGINAL PROJECTIONS

	Ag & Food Products	Oil & Industrial Products	Coal	Intermodal	Other	Total
Rail	-	-	-	-	-	-
Pipeline	-	-	-		-	-
Barge	-	-	-		-	-
Truck	-	-	-		-	-
Air, Other & Unknown	-	-	-		-	-
Overall Improvement	-	(0)	(0)	-	-	(0)
	0%	0%	0%	0%	0%	

SCENARIO 1: **Pipelines gain 5% capacity (equivalent to 11 shuttles per day or 4,000 shuttles per year)**
Results: The maximum volume of oil was routed to pipelines and extra rail capacity was assinged to grains, now 29,372 shuttles (a 1% improvement)

	Ag & Food Products	Oil & Industrial Products	Coal	Intermodal	Other	TOTAL	MAX CAPACITY
Rail	29,372	10,491	63,369	120,852	56,408	280,492	280,492
Pipeline	-	81,379	-	-	-	81,379	81,379
Barge	7,158	20,466	6,985	-	18,042	52,651	52,651
Truck	248,126	132,137	41,221	-	1,133,383	1,554,867	1,554,867
Air, Other & Unknown	2,066	1,644	7,578	-	18,110	29,398	29,398
TOTAL	286,722	246,117	119,154	120,852	1,225,943	1,998,787	
MIN SHIPMENTS	282,720	246,117	119,153	120,851	1,225,942		

COMPARISON TO ORIGINAL PROJECTIONS

	Ag & Food Products	Oil & Industrial Products	Coal	Intermodal	Other	Total
Rail	4,000	(4,000)	(0)	(0)	0	(0)
Pipeline	-	4,000	-		-	4,000
Barge	(0)	(0)	(0)		0	(0)
Truck	0	(0)	0		0	0
Air, Other & Unknown	0	(0)	0		0	0
Overall Improvement	4,001	(0)	(0)	(0)	1	4,001
	1%	0%	0%	0%	0%	

SCENARIO 2: **Rail gains 5% capacity**
Results: All categories gain volume: 1% more ag (now 28,176 shuttles), 1% more oil (now 17,297 shuttles), 2% more coal (now 66,174 shuttles), 2% more intermodal (now 123,657 shuttles)

	Ag & Food Products	Oil & Industrial Products	Coal	Intermodal	Other	TOTAL	MAX CAPACITY
Rail	28,176	17,297	66,174	123,657	59,213	294,517	294,517
Pipeline	-	77,379	-	-	-	77,379	77,379
Barge	7,158	20,466	6,985	-	18,042	52,651	52,651
Truck	248,126	132,137	41,221	-	1,133,383	1,554,867	1,554,867
Air, Other & Unknown	2,066	1,644	7,578	-	18,110	29,398	29,398
TOTAL	285,526	248,923	121,959	123,657	1,228,748	2,008,812	
MIN SHIPMENTS	282,720	246,117	119,153	120,851	1,225,942		

COMPARISON TO ORIGINAL PROJECTIONS

	Ag & Food Products	Oil & Industrial Products	Coal	Intermodal	Other	Total
Rail	2,805	2,805	2,805	2,805	2,805	14,024
Pipeline	-	0	-		-	0
Barge	(0)	(0)	(0)		0	(0)
Truck	0	0	0		0	0
Air, Other & Unknown	(0)	0	0		0	0
Overall Improvement	2,805	2,805	2,805	2,805	2,806	14,025
	1%	1%	2%	2%	0%	

SCENARIO 3: **Barge gains 5% capacity**
Results: Evenly distributed across categories, the only significant influence is to coal (now 7,643 shuttles' worth, a 1% improvement)

	Ag & Food Products	Oil & Industrial Products	Coal	Intermodal	Other	TOTAL	MAX CAPACITY
Rail	25,371	14,492	63,369	120,852	56,408	280,492	280,492
Pipeline	-	77,379	-	-	-	77,379	77,379
Barge	7,817	21,124	7,643	-	18,700	55,284	55,284
Truck	248,126	132,137	41,221	-	1,133,383	1,554,867	1,554,867
Air, Other & Unknown	2,066	1,644	7,578	-	18,110	29,398	29,398
TOTAL	283,379	246,776	119,812	120,852	1,226,601	1,997,420	
MIN SHIPMENTS	282,720	246,117	119,153	120,851	1,225,942		

COMPARISON TO ORIGINAL PROJECTIONS

	Ag & Food Products	Oil & Industrial Products	Coal	Intermodal	Other	Total
Rail	(0)	(0)	(0)	(0)	0	(0)
Pipeline	-	0	-		-	0
Barge	658	658	658		658	2,632
Truck	0	0	(0)		0	0
Air, Other & Unknown	0	(0)	(0)		0	0
Overall Improvement	658	658	658	(0)	659	2,633
	0%	0%	1%	0%	0%	

SCENARIO 4: **Truck gains 5% capacity**
Results: Huge increase (extra 77,743 shuttles' worth). Most directed to ag (now 267,562, up 14%), then coal (now 60,657, up 16%) and other (now 1,152,819, up 2%)

	Ag & Food Products	Oil & Industrial Products	Coal	Intermodal	Other	TOTAL	MAX CAPACITY
Rail	39,863	-	63,369	120,852	56,408	280,492	280,492
Pipeline	-	77,379	-	-	-	77,379	77,379
Barge	12,103	15,521	6,985	-	18,042	52,651	52,651
Truck	267,562	151,573	60,657	-	1,152,819	1,632,610	1,632,610
Air, Other & Unknown	2,066	1,644	7,578	-	18,110	29,398	29,398
TOTAL	321,593	246,117	138,590	120,852	1,245,378	2,072,530	
MIN SHIPMENTS	282,720	246,117	119,153	120,851	1,225,942		

COMPARISON TO ORIGINAL PROJECTIONS

	Ag & Food Products	Oil & Industrial Products	Coal	Intermodal	Other	Total
Rail	14,492	(14,492)	(0)	(0)	0	(0)
Pipeline	-	0	-		-	0
Barge	4,944	(4,945)	(0)		0	(0)
Truck	19,436	19,436	19,436		19,436	77,744
Air, Other & Unknown	0	(0)	0		0	0
Overall Improvement	38,872	(0)	19,436	(0)	19,437	77,744
	14%	0%	16%	0%	2%	

SCENARIO 5: **Rail gains 4,000 shuttles of capacity**
Results: Extra capacity gets evenly distributed to all categories with negligible effects (ag total now 283,521 shuttle equivalents)

	Ag & Food Products	Oil & Industrial Products	Coal	Intermodal	Other	TOTAL	MAX CAPACITY
Rail	26,171	15,292	64,169	121,652	57,208	284,492	284,492
Pipeline	-	77,379	-	-	-	77,379	77,379
Barge	7,158	20,466	6,985	-	18,042	52,651	52,651
Truck	248,126	132,137	41,221	-	1,133,383	1,554,867	1,554,867
Air, Other & Unknown	2,066	1,644	7,578	-	18,110	29,398	29,398
TOTAL	283,521	246,918	119,954	121,652	1,226,743	1,998,787	
MIN SHIPMENTS	282,720	246,117	119,153	120,851	1,225,942		

COMPARISON TO ORIGINAL PROJECTIONS

	Ag & Food Products	Oil & Industrial Products	Coal	Intermodal	Other	Total
Rail	800	800	800	800	800	4,000
Pipeline	-	0	-		-	0
Barge	(0)	(0)	(0)		0	(0)
Truck	0	0	0		0	0
Air, Other & Unknown	(0)	0	0		0	0
Overall Improvement	800	800	800	800	801	4,001
	0%	0%	1%	1%	0%	

APPENDIX II (CONTINUED)

SCENARIO 6: **Barge gains 4,000 shuttle equivalents of capacity**
Results: Ag, oil, coal, and other volumes grow (1,000 shuttles' worth each). Signficant benefit to coal (up 1%).

	Ag & Food Products	Oil & Industrial Products	Coal	Intermodal	Other	TOTAL	MAX CAPACITY
Rail	25,371	14,492	63,369	120,852	56,408	280,492	280,492
Pipeline	-	77,379	-	-	-	77,379	77,379
Barge	8,158	21,466	7,985	-	19,042	56,651	56,651
Truck	248,126	132,137	41,221	-	1,133,383	1,554,867	1,554,867
Air, Other & Unknown	2,066	1,644	7,578	-	18,110	29,398	29,398
TOTAL	283,721	247,118	120,154	120,852	1,226,943	1,998,787	
MIN SHIPMENTS	282,720	246,117	119,153	120,851	1,225,942		

COMPARISON TO ORIGINAL PROJECTIONS

	Ag & Food Products	Oil & Industrial Products	Coal	Intermodal	Other	
Rail	(0)	(0)	(0)	(0)	0	**(0)**
Pipeline	-	0	-		-	**0**
Barge	1,000	1,000	1,000		1,000	**4,000**
Truck	0	0	0		0	**0**
Air, Other & Unknown	0	(0)	(0)		0	**0**
Overall Improvement	**1,000**	**1,000**	**1,000**	**(0)**	**1,001**	**4,001**
	0%	**0%**	**1%**	**0%**	**0%**	

SCENARIO 7: **Truck gains 4,000 shuttle equivalents of capacity**
Results: Net 2,000 get routed to ag, 1,000 to coal, and 1,000 to other. Significant for ag (up 1%) and coal (up 1%)

	Ag & Food Products	Oil & Industrial Products	Coal	Intermodal	Other	TOTAL	MAX CAPACITY
Rail	26,372	13,491	63,369	120,852	56,408	280,492	280,492
Pipeline	-	77,379	-	-	-	77,379	77,379
Barge	7,158	20,466	6,985	-	18,042	52,651	52,651
Truck	249,126	133,137	42,221	-	1,134,383	1,558,867	1,558,867
Air, Other & Unknown	2,066	1,644	7,578	-	18,110	29,398	29,398
TOTAL	284,722	246,117	120,154	120,852	1,226,943	1,998,787	
MIN SHIPMENTS	282,720	246,117	119,153	120,851	1,225,942		

COMPARISON TO ORIGINAL PROJECTIONS

	Ag & Food Products	Oil & Industrial Products	Coal	Intermodal	Other	
Rail	1,000	(1,000)	(0)	(0)	0	**(0)**
Pipeline	-	0	-		-	**0**
Barge	(0)	(0)	(0)		0	**(0)**
Truck	1,000	1,000	1,000		1,000	**4,000**
Air, Other & Unknown	0	(0)	0		0	**0**
Overall Improvement	**2,001**	**(0)**	**1,000**	**(0)**	**1,001**	**4,001**
	1%	**0%**	**1%**	**0%**	**0%**	

SCENARIO 8: **Both pipelines and rail get 5% more capacity**
Results: Naturally the biggest gain for oil, up 6,674 or 3% overall. 2% gains for coal and intermodal; 1% gains for ag.

	Ag & Food Products	Oil & Industrial Products	Coal	Intermodal	Other	TOTAL	MAX CAPACITY
Rail	26,176	17,297	66,174	123,657	59,213	294,517	294,517
Pipeline	-	81,248	-	-	-	81,248	81,248
Barge	7,158	20,466	6,985	-	18,042	52,651	52,651
Truck	248,126	132,137	41,221	-	1,133,383	1,554,867	1,554,867
Air, Other & Unknown	2,066	1,644	7,578	-	18,110	29,398	29,398
TOTAL	283,526	252,792	121,959	123,657	1,228,748	2,012,681	
MIN SHIPMENTS	282,720	246,117	119,153	120,851	1,225,942		

COMPARISON TO ORIGINAL PROJECTIONS

	Ag & Food Products	Oil & Industrial Products	Coal	Intermodal	Other	
Rail	2,805	2,805	2,805	2,805	2,805	**14,024**
Pipeline	-	3,869	-		-	**3,869**
Barge	(0)	(0)	(0)		0	**(0)**
Truck	0	0	0		0	**0**
Air, Other & Unknown	(0)	0	0		0	**0**
Overall Improvement	**2,805**	**6,674**	**2,805**	**2,805**	**2,806**	**17,894**
	1%	**3%**	**2%**	**2%**	**0%**	

SCENARIO 9: **All methods gain 5% capacity**
Results: Biggest volume gains for oil (an extra 26,279 mostly by truck) and Other (an extra 26,018 mostly by truck). Most signficant effects on coal (up 19%) and oil (up 11%). Grain up 8%, now 305,131 by all methods, biggest gains from truck (extra 19,210 shuttles' worth) and rail (extra 2,624 shuttles).

	Ag & Food Products	Oil & Industrial Products	Coal	Intermodal	Other	TOTAL	MAX CAPACITY
Rail	27,996	17,116	65,994	123,476	59,934	294,517	294,517
Pipeline	-	81,248	-	-	-	81,248	81,248
Barge	7,591	20,899	7,418	-	19,376	55,284	55,284
Truck	267,336	151,347	60,432	-	1,153,495	1,632,610	1,632,610
Air, Other & Unknown	2,208	1,786	7,720	-	19,154	30,868	30,868
TOTAL	305,131	272,396	141,564	123,476	1,251,960	2,094,526	
MIN SHIPMENTS	282,720	246,117	119,153	120,851	1,225,942		

COMPARISON TO ORIGINAL PROJECTIONS

	Ag & Food Products	Oil & Industrial Products	Coal	Intermodal	Other	
Rail	2,624	2,624	2,624	2,624	3,527	**14,024**
Pipeline	-	3,869	-		-	**3,869**
Barge	433	433	433		1,335	**2,632**
Truck	19,210	19,210	19,210		20,113	**77,744**
Air, Other & Unknown	142	142	142		1,044	**1,470**
Overall Improvement	**22,410**	**26,279**	**22,410**	**2,624**	**26,018**	**99,740**
	8%	**11%**	**19%**	**2%**	**2%**	

SCENARIO 10: **All methods' capacities gain 51% to match DOT's 2040 projection**
Results: Coal and oil the biggest beneficiaries (nearly 3 times the coal, more than double the oil). Grain volumes up 84%.

	Ag & Food Products	Oil & Industrial Products	Coal	Intermodal	Other	TOTAL	MAX CAPACITY
Rail	53,801	42,922	91,799	149,281	85,740	423,543	423,543
Pipeline	-	116,842	-	-	-	116,842	116,842
Barge	13,646	26,953	13,473	-	25,431	79,503	79,503
Truck	446,146	330,157	239,241	-	1,332,305	2,347,849	2,347,849
Air, Other & Unknown	5,588	5,167	11,101	-	22,534	44,391	44,391
TOTAL	519,181	522,041	355,614	149,281	1,466,010	3,012,128	
MIN SHIPMENTS	282,720	246,117	119,153	120,851	1,225,942		

COMPARISON TO ORIGINAL PROJECTIONS

	Ag & Food Products	Oil & Industrial Products	Coal	Intermodal	Other	
Rail	28,430	28,430	28,430	28,430	29,332	**143,051**
Pipeline	-	39,464	-		-	**39,464**
Barge	6,487	6,487	6,487		7,390	**26,852**
Truck	198,020	198,020	198,020		198,922	**792,983**
Air, Other & Unknown	3,523	3,523	3,523		4,425	**14,993**
Overall Improvement	**236,460**	**275,924**	**236,460**	**28,430**	**240,068**	**1,017,342**
	84%	**112%**	**198%**	**24%**	**20%**	

SCENARIO 11: **Pipeline capacity gains 4,000 shuttle equivalents; Rail capacity gains 5%; Grain receives favorable intervention by limiting oil, coal, intermodal, and other to their baseline volumes**
Results: Grain does receive the extra 14,024 shuttles and shipment volume increases 5%.

	Ag & Food Products	Oil & Industrial Products	Coal	Intermodal	Other	TOTAL	MAX CAPACITY
Rail	39,396	14,492	63,369	120,852	56,408	294,517	294,517
Pipeline	-	81,379	-	-	-	81,379	81,379
Barge	7,158	20,466	6,985	-	18,042	52,651	52,651
Truck	248,126	132,137	41,221	-	1,133,383	1,554,867	1,554,867
Air, Other & Unknown	2,066	1,644	7,578	-	18,110	29,398	29,398
TOTAL	296,745	250,118	119,154	120,852	1,225,942	2,012,812	
MIN SHIPMENTS	282,720	246,117	119,153	120,851	1,225,942		

COMPARISON TO ORIGINAL PROJECTIONS

	Ag & Food Products	Oil & Industrial Products	Coal	Intermodal	Other	
Rail	14,024	0	(0)	0	0	**14,024**
Pipeline	-	4,000	-		-	**4,000**
Barge	(0)	(0)	(0)		0	**(0)**
Truck	0	0	0		0	**0**
Air, Other & Unknown	0	0	0		0	**0**
Overall Improvement	**14,024**	**4,001**	**(0)**	**0**	**0**	**18,025**
	5%	**2%**	**0%**	**0%**	**0%**	

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