U.S. Rail Crude Oil Traffic

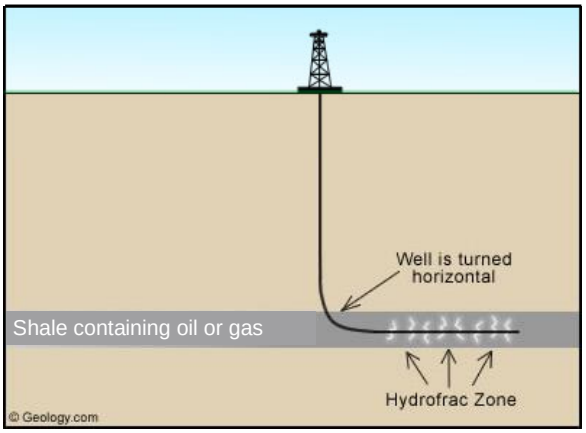
ASSOCIATION OF AMERICAN RAILROADS **NOVEMBER 2015**

Summary

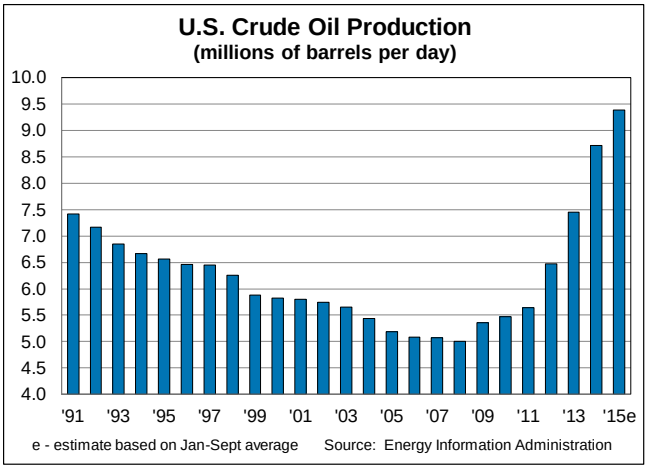
U.S. crude oil production has risen sharply in recent years, with much of the increased output moving by rail. In 2008, U.S. Class I railroads originated 9,500 carloads of crude oil. In 2014, they originated 493,146 carloads, an increase of nearly 5,100 percent. Rail crude oil volumes in 2015 will be lower than in 2014. Additional pipelines will probably be built in the years ahead, but the competitive advantages railroads offer — including flexibility to serve disparate markets — could keep them in the crude oil transportation market long into the future.

The Shale Revolution Has Led to Sharply Higher Crude Oil Production

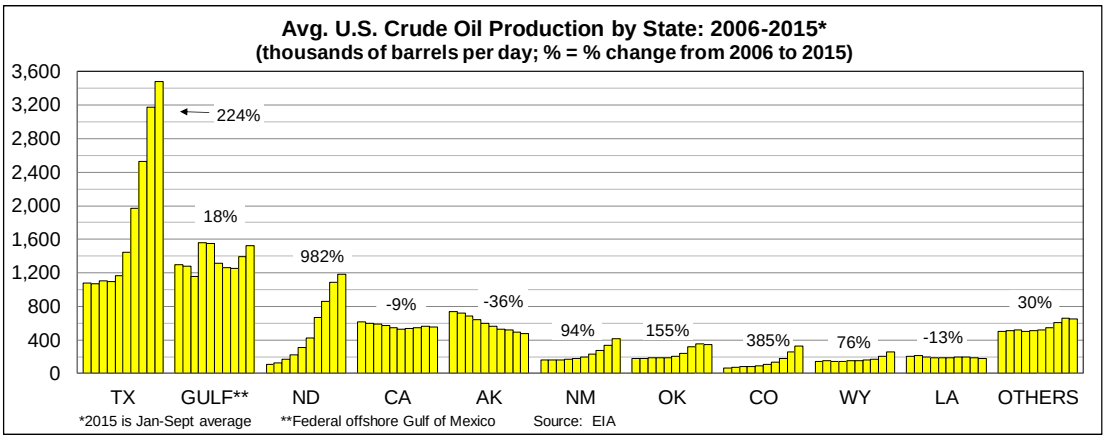
- Throughout the world, huge quantities of crude oil and natural gas are trapped in non-permeable shale rock. In recent years, technological advances — especially in hydraulic fracturing ("fracking") and horizontal drilling — have made recovery of much of this oil and gas economically feasible.



- The most important U.S. shale deposits are the Bakken, mainly in North Dakota; Barnett, Eagle Ford, and Permian in Texas; Marcellus in the east, especially Pennsylvania and Ohio; and Niobrara in Wyoming and Colorado. Some areas contain more natural gas than crude oil; others contain more oil than natural gas. There are still many unknowns (including the long-term output of shale wells), but it's clear that, thanks to shale, economically recoverable U.S. gas and oil reserves are much greater than they were thought to be just a few years ago.



- U.S. crude oil production peaked in 1970 at 9.6 million barrels per day, and by 2008 it had fallen to 5.0 million barrels as new production failed to keep pace with depletion of older fields. By the first nine months of 2015, though, U.S. crude oil production had surged to an average of 9.4 million barrels per day.



- Much of the recent increase has been in North Dakota, where crude oil production rose from an average of 81,000 barrels per day in 2003 to 1.2 million barrels per day in the first nine months of 2015, making it the second-largest oil producing state. Crude oil output in Texas has skyrocketed since 2009, reaching an average of 3.5 million barrels per day in the first nine months of 2015.

- It's difficult to overstate the economic benefits associated with continued growth in domestic crude oil production. Over time, it would mean:

  ✓ Reduced reliance on oil from sources in the world that are not secure and whose interests do not necessarily correspond well to those of the United States.

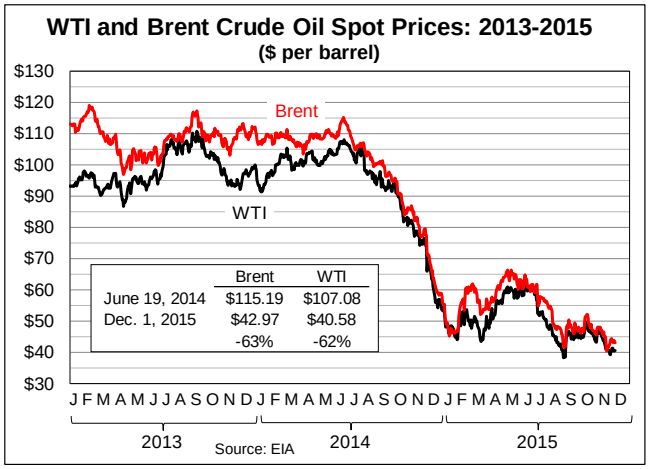
  ✓ Reduced vulnerability to oil shocks that in the past have caused immense harm to the U.S. economy.

  ✓ New and better employment and economic development opportunities for communities all over the country.

  ✓ Billions of dollars in new tax revenues.

  ✓ Reductions in the U.S. trade deficit of tens of billions of dollars every year.

- The surge in U.S. crude oil output, combined with relatively weak global demand for crude oil due to economic weakness in many countries, has led to an oversupply of crude oil and a sharp decline in crude oil prices beginning around June 2014. As of November 2015, crude oil spot prices were more than 60 percent lower than they were in June 2014 (see the chart at right).



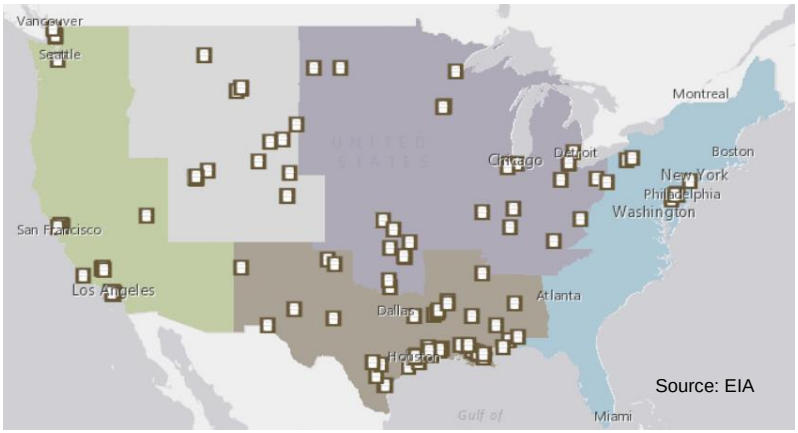
- How much crude oil is produced in the United States — and therefore how much railroads will be called upon to haul — will depend on how long the low prices last, the price competitiveness of crude oil imports in the U.S. market, and other market factors.

Volumes of Crude Oil by Rail

The growth in domestic crude oil production presents a tremendous opportunity for the United States to move closer to energy independence. Railroads are crucial to this effort:

- Crude oil has little value unless it can be transported to refineries, but most U.S. refineries are located in traditional crude oil production areas (Texas, Oklahoma, Louisiana) or on the coasts where crude oil transported by tanker is readily accessible (California, Washington, New England, Gulf of Mexico), rather than near new production areas like North Dakota. It's impossible for refineries to come on line quickly near the new production areas, in part because it takes so long to obtain necessary permits.

U.S. Crude Oil Refineries



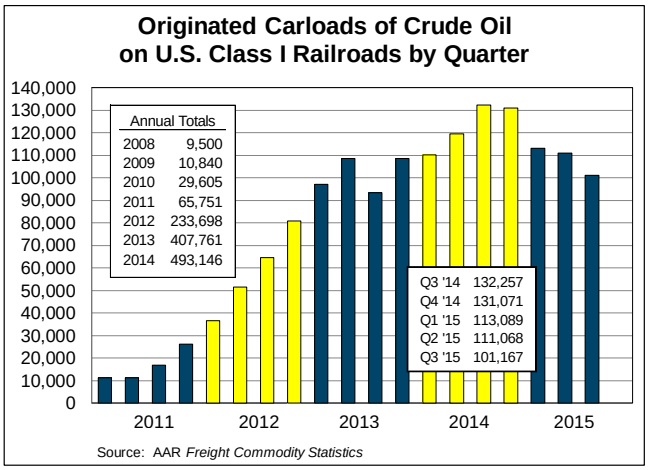
- Historically, pipelines have transported most crude oil. However, in North Dakota, the pipeline network has lacked the capacity to handle the higher production the state has seen. Railroads have been filling this gap.

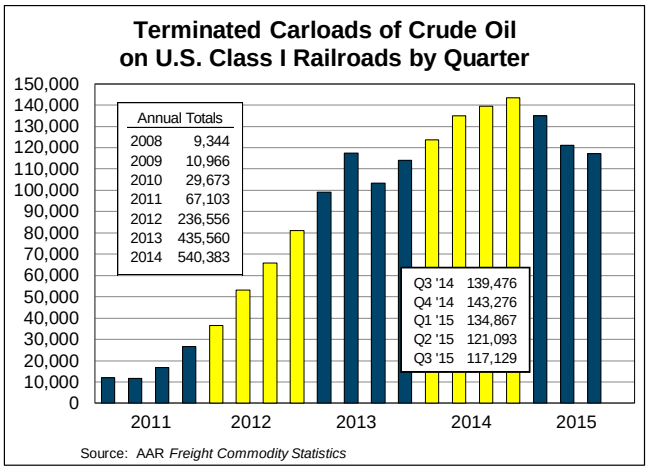
- In recent years, as U.S. crude oil output has surged, so too have crude oil carloads on U.S. railroads. Originated carloads of crude oil on U.S. Class I railroads (including the U.S. subsidiaries of Canadian railroads) rose from 9,500 in 2008 to 493,146 in 2014. Terminated carloads of crude oil on U.S. Class I railroads rose from 9,344 in 2008 to 540,383 in 2014.[1] However, rail carloads of crude oil are down noticeably in the first three quarters of 2015 compared with 2014 (see the charts on the top of the next page).

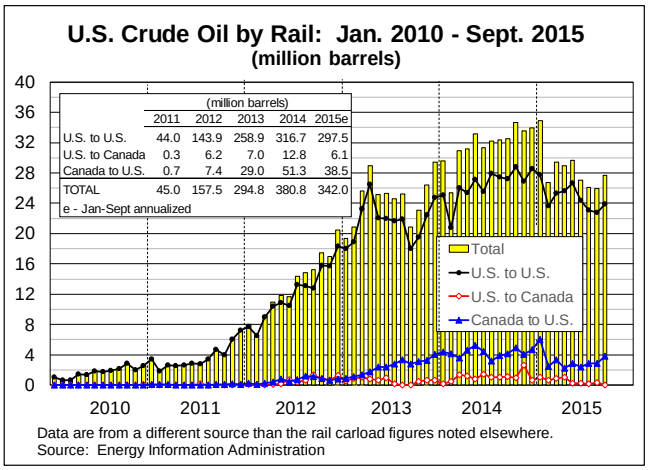
- Crude oil has clearly become an important commodity for U.S. railroads, but one must be careful not to overestimate its importance. Despite its rapid growth, crude oil accounted for just 1.6 percent of total originated carloads on Class I railroads in 2014 and just 1.5 percent in the first three quarters of 2015.

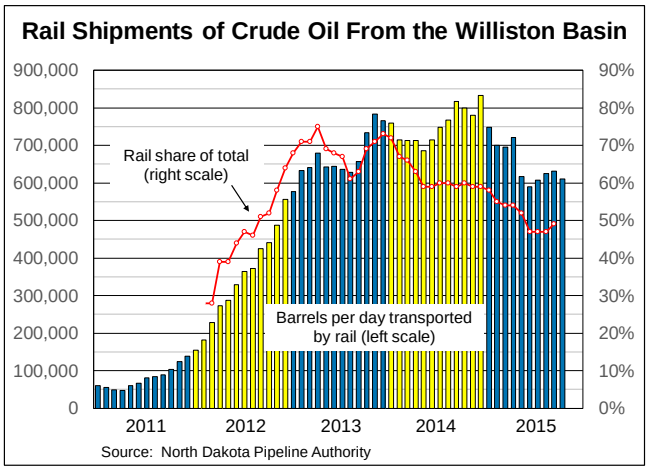
- The average U.S. rail carload of crude oil today contains approximately 725 barrels of oil. Using that figure, the 493,146 carloads of crude oil originated by U.S. Class I railroads in 2014 was equivalent to around 980,000 barrels per day. According to data from the Energy Information Administration (EIA), U.S. crude oil production in 2014 was 8.7 million barrels per day, so the rail share was approximately 11 percent of the total.

[1] "Originated" carloads are loaded carloads beginning a rail journey; "terminated" carloads are loaded carloads completing a rail journey. U.S. Class I originations do not equal U.S. Class I terminations because some crude oil that originates on U.S. Class I railroads is terminated by U.S. short line railroads or by railroads in Canada. Likewise, some crude oil that terminates on U.S. Class I railroads originates on railroads in Canada or on U.S. short line railroads.



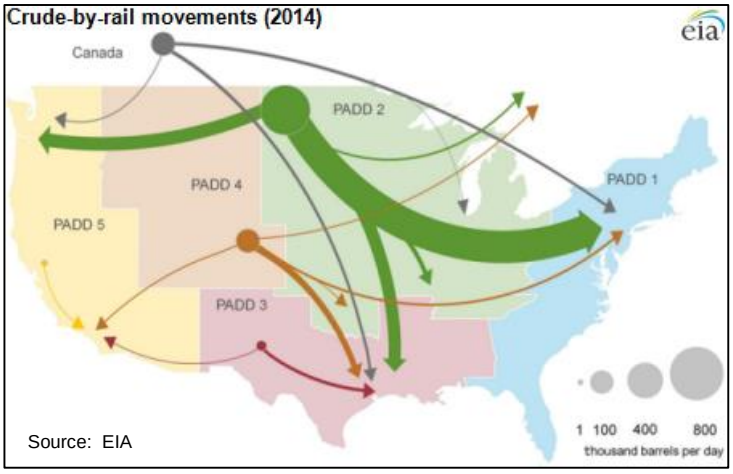






- The Bakken region has accounted for the vast majority of rail crude oil originations in recent years. According to the North Dakota Pipeline Authority, by mid-2015 around 600,000 barrels of crude oil per day were moving out of the area by rail, down from a peak of around 800,000 barrels per day in late 2014 (see the chart above right).

- The EIA combines data from the AAR and other sources to produce estimates of crude oil by rail movements by month between the United States and Canada and between various Petroleum Administration for Defense Districts (PADDs). U.S.-to-U.S. movements dominate U.S. rail crude oil volume, though Canada-to-U.S. movements rose sharply through 2014 (though they've fallen in 2015 — see the chart above left and the table on the next page).



CRUDE OIL BY RAIL FROM PADD 2 TO:

	PADD 1	PADD 2	PADD 3	PADD 5	Canada	TOTAL
	(million barrels)					
2011	2.05	13.19	15.61	1.61	0.26	32.71
2012	18.88	15.34	74.18	7.95	6.17	122.52
2013	79.49	21.44	88.29	33.17	6.78	229.17
2014	133.78	10.49	53.34	52.65	11.16	261.41
2015e	157.60	8.23	30.12	49.26	6.85	250.31
	(% of PADD 2 total)					
2011	6%	40%	48%	5%	1%	100%
2012	15%	13%	61%	6%	5%	100%
2013	35%	9%	39%	14%	3%	100%
2014	51%	4%	20%	20%	4%	100%
2015e	63%	3%	12%	20%	3%	100%

PADD 4 = 0 for all years e - Jan-Sept annualized Source: EIA

CRUDE OIL BY RAIL FROM PADD 3 TO:

	PADD 2	PADD 3	PADD 5	Canada	TOTAL
	(million barrels)				
2011	0.24	7.31	0.00	0.00	7.55
2012	0.34	19.43	0.40	0.00	20.16
2013	0.00	21.56	0.62	0.00	22.18
2014	0.00	13.80	2.00	0.00	15.80
2015e	0.00	6.44	2.95	0.00	8.99
	(% of PADD 2 total)				
2011	3%	97%	0%	0%	100%
2012	2%	96%	2%	0%	100%
2013	0%	97%	3%	0%	100%
2014	0%	87%	13%	0%	100%
2015e	0%	72%	33%	0%	100%

PADD 1 & 4 = 0 all years e - Jan-Sept annualized Source: EIA

CRUDE OIL BY RAIL FROM PADD 4 TO:

	PADD 1	PADD 2	PADD 3	PADD 5	Canada	TOTAL
	(million barrels)					
2011	0.00	0.00	0.99	0.00	0.00	0.99
2012	0.00	0.75	3.88	0.27	0.00	4.90
2013	0.11	0.31	8.97	0.90	0.17	10.46
2014	9.41	2.61	31.40	4.30	1.63	49.35
2015e	8.12	2.12	33.91	5.14	0.00	49.29
	(% of PADD 4 total)					
2011	0%	0%	100%	0%	0%	100%
2012	0%	15%	79%	5%	0%	100%
2013	1%	3%	86%	9%	2%	100%
2014	19%	5%	64%	9%	3%	100%
2015e	16%	4%	69%	10%	0%	100%

PADD 4 = 0 for all years e - Jan-Sept annualized Source: EIA

CRUDE OIL BY RAIL FROM CANADA TO:

	PADD 1	PADD 2	PADD 3	PADD 5	TOTAL
	(million barrels)				
2011	0.00	0.00	0.46	0.27	0.73
2012	4.11	0.33	2.41	0.60	7.45
2013	11.26	1.23	14.09	2.44	29.01
2014	25.34	0.62	21.03	4.28	51.28
2015e	12.45	0.72	23.89	3.45	39.29
	(% of from Canada total)				
2011	0%	0%	63%	37%	100%
2012	55%	4%	32%	8%	100%
2013	39%	4%	49%	8%	100%
2014	49%	1%	41%	8%	100%
2015e	32%	2%	61%	9%	100%

PADD 4 = 0 for all years e - Jan-Sept annualized Source: EIA

- The map on the bottom of the previous page and the tables above have data compiled by the EIA. EIA's data show that PADD 1 (the East Coast) has become the primary recipient of crude oil by rail from PADD 2 (predominantly North Dakota). In 2011, PADD 1 received just 2.05 million barrels of crude oil by rail from PADD 2, equal to 6% of PADD 2's total (see the table above left). Based on data from January through September, PADD 1 is on pace to receive approximately 158 million barrels by rail from PADD 2 in 2015, or 63% of PADD 2's total. PADD 3's (Texas, Gulf Coast) share of PADD 2's shipments was 18% in 2015 through September, down from 61% in 2012 and 39% in 2013.

Advantages of Transporting Crude Oil by Rail

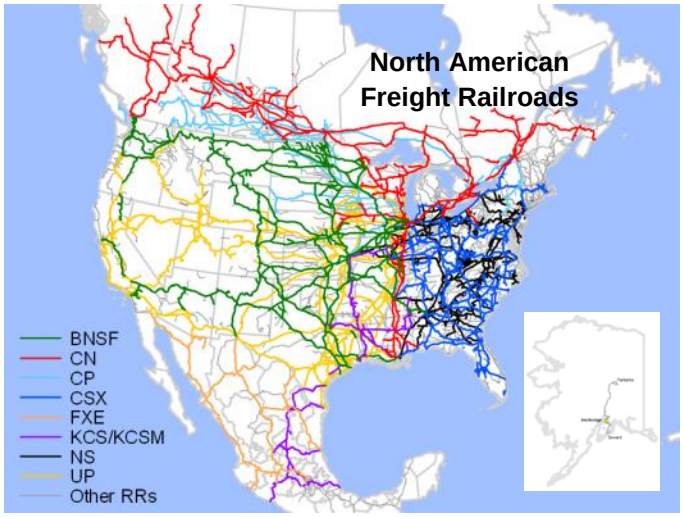
Pipelines have traditionally transported most crude oil, but in recent years railroads have become critical players. In addition to the critical fact that railroads provide transportation capacity in many areas where pipeline capacity is insufficient, railroads offer other advantages:

- Geographical flexibility. Railroads serve or could serve nearly every refinery in the United States and Canada, giving market participants enormous flexibility to shift product quickly to different places in response to market needs and price opportunities.

Railroad Crude Oil Loading and Unloading Terminals

- Responsiveness. Rail facilities can almost always be built or expanded much more quickly than pipelines and refineries, making it much more likely that railroads will be able to keep up with production growth in emerging oil fields.

- Efficiency. As new rail facilities are developed, railroads are involved every step of the way. For example, at origin and destination sites, railroad economic development and operations teams help facility owners decide where to locate assets and how to lay out rail infrastructure on the site to maximize efficiency.



Railroads also help crude oil customers find ways to load and unload tank cars more quickly and reduce en-route delays. Promoting unit train shipments is often a key part of this process. Unit trains are long trains (usually at least 50 and sometimes more than 100 cars) consisting of a single commodity. They often use dedicated equipment and generally follow direct shipping routes to and from facilities designed to load and unload them efficiently. A unit train might carry more than 70,000 barrels of oil and be loaded or unloaded in 24 hours. In the first quarter of 2015, 87 percent of rail crude oil movements were in blocks of 20 or more cars and 78 percent were in blocks of 50 or more cars.

- Spending. In recent years, railroads have spent billions of dollars on infrastructure and equipment to enhance their ability to transport crude oil and other commodities.

Even as more pipelines are built or expanded, railroads will continue to provide a set of advantages — especially flexibility — that will enable them to continue to play a key role in the crude oil market long into the future.