Moving Crude Oil by Rail

ASSOCIATION OF AMERICAN RAILROADS SEPTEMBER 2014

Summary

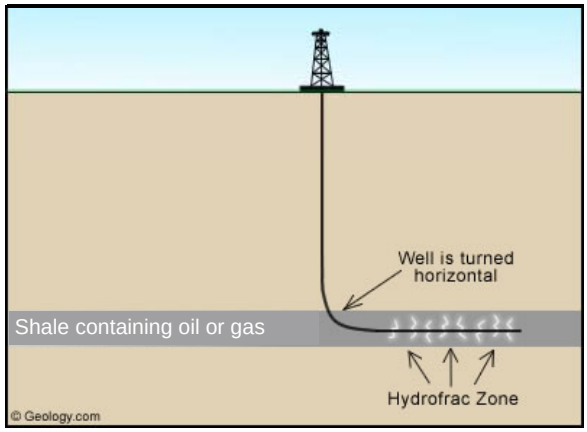
U.S. crude oil production has risen sharply in recent years, with much of the increased output moving by rail. In 2008, U.S. Class I railroads originated 9,500 carloads of crude oil. In 2013, they originated 407,761 carloads. In the first half of 2014, it was 229,798 carloads.

In light of these increased volumes, railroads have taken numerous steps to enhance crude oil safety. They've undertaken top-to-bottom reviews of their operations and voluntarily updated their operating practices, from the selection of routes, to train speeds, to track and equipment inspections. Railroads already provide training to more than 20,000 emergency responders each year, but they are increasing their efforts to train first responders and have created an inventory of emergency response resources along their lines. In addition to reviewing their own operations to make them safer, railroads are urging federal regulators to toughen existing standards for new tank cars and require that existing tank cars used to transport crude oil be retrofitted with safety-enhancing technologies or, if not upgraded, aggressively phased out.

Additional pipelines will probably be built in the years ahead, but the competitive advantages railroads offer will keep them in the crude oil transportation market long into the future.

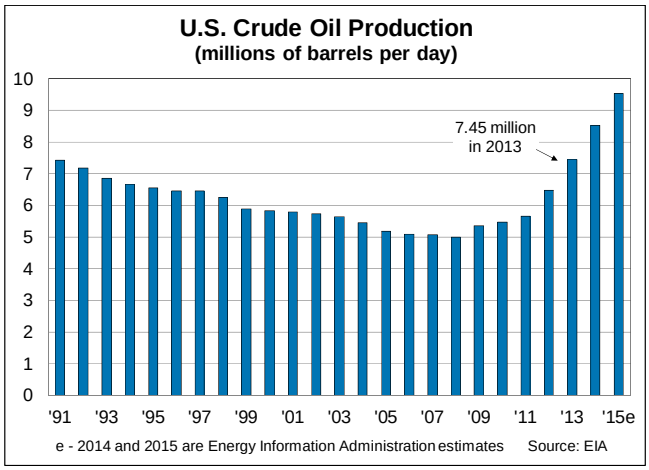
The Shale Revolution Has Led to Sharply Higher Crude Oil Production

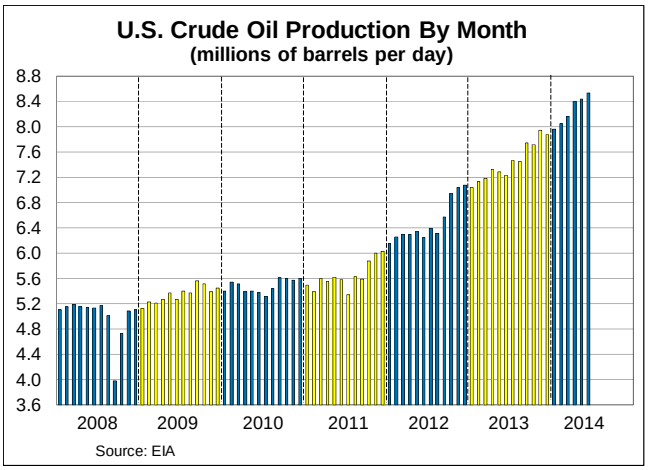
- Throughout the world, huge quantities of crude oil and natural gas are trapped in non-permeable shale rock. Over the past few years, technological advances — especially in hydraulic fracturing ("fracking") and horizontal drilling — along with higher crude oil prices have made recovery of much of this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



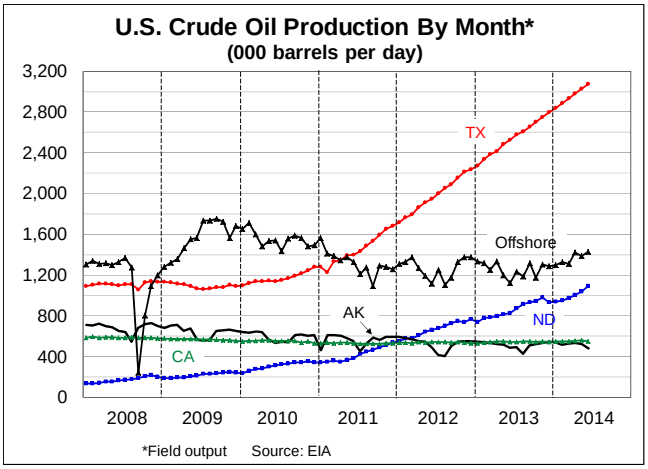
- To date, the most important U.S. shale deposits are Bakken, mainly in North Dakota; Barnett in Texas; and Marcellus in the east, especially in Pennsylvania and Ohio. Other key shale areas include Niobrara in Wyoming and Colorado, and Eagle Ford and Permian in Texas. Some areas contain more natural gas than crude oil; others contain more oil than natural gas. There are still many unknowns — including the long-term productivity of shale wells — but it's clear that, thanks to shale, economically recoverable U.S. gas and oil reserves are far higher 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, but by 2008 had fallen to 5.0 million barrels as new production failed to keep pace with depletion of older fields. By 2013, though, U.S. crude oil production had rebounded to 7.45 million barrels per day, and according to Energy Information Administration projections, it will average 8.5 million barrels per day in 2014 and 9.5 million barrels per day in 2015.





- Much of the recent increase in crude oil production has been in North Dakota, where crude oil production rose from an average of 81,000 barrels per day in 2003 to more than one million barrels per day by mid-2014, making it the second-largest oil producing state. Crude oil output in Texas, the top crude oil producing state, was relatively flat from 2003 to 2009, but has skyrocketed since then, exceeding three million barrels per day by mid-2014.



- It's hard to overstate the economic and security benefits associated with continued growth in domestic crude oil production. Over time, it will mean reductions in the nation's trade deficit of tens of billions of dollars every year, new and better employment opportunities for hundreds of thousands of Americans, and better economic development opportunities for regions all over the country. It will mean billions of dollars in new tax revenues. And it will mean reduced reliance on sources of oil from places in the world that are not secure and whose interests do not necessarily correspond well to those of the United States, and less vulnerability to oil shocks that can cause immense harm to our economy.

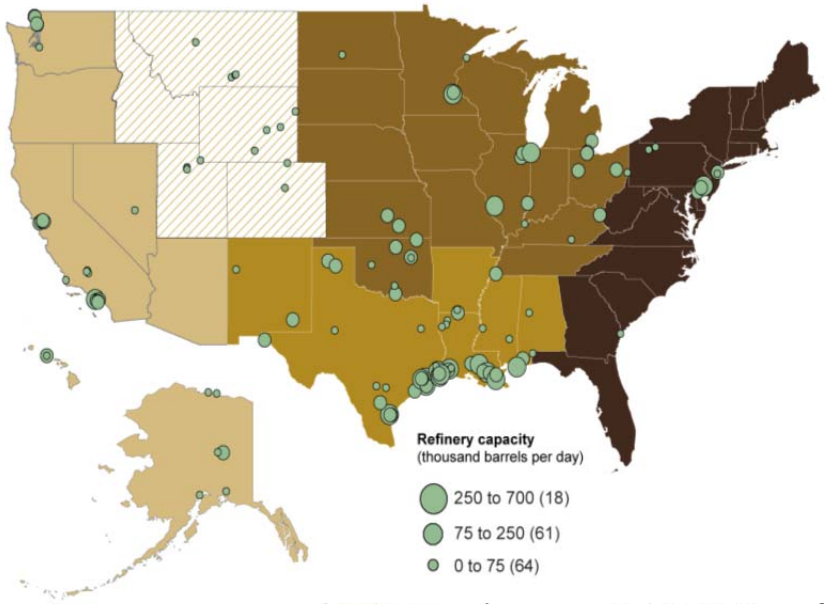
- The Peterson Institute, a well-respected, nonprofit, and nonpartisan research institution devoted to the study of international economic policy, recently found that, along with lower energy costs, the growth in domestic energy production should increase annual U.S. GDP growth between 0.09 and 0.19 percentage points through 2020. That adds up to hundreds of billions of dollars in higher GDP.

Transporting Crude Oil by Rail

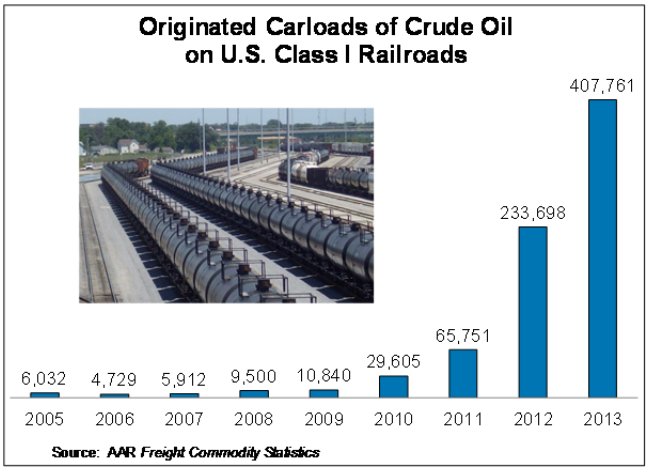
As indicated above, the growth in domestic crude oil production represents a tremendous opportunity for our nation to move closer to energy independence and to benefit in many other ways. Our nation can't take full advantage of our new crude oil resources without railroads.

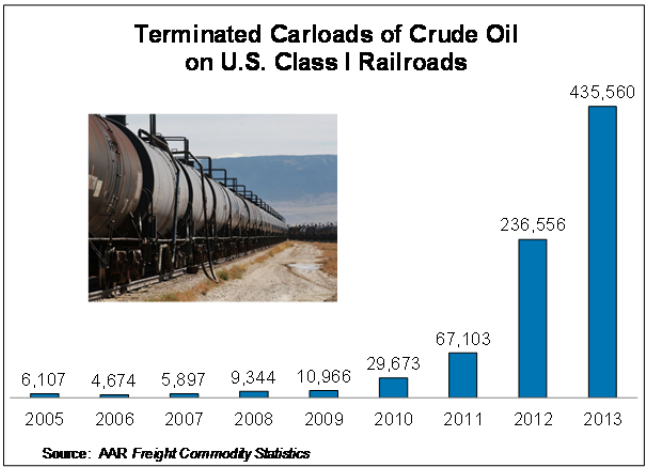
- Crude oil has little value unless it can be transported to refineries, but most U.S. refineries are located in traditional crude oil production areas (Texas, Oklahoma) or on the coasts where crude oil transported by tanker is readily accessible (California, Washington, New England, Gulf of Mexico),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

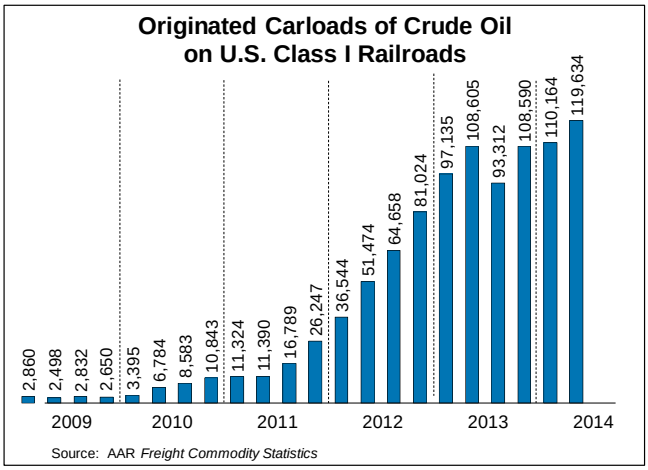
U.S. Crude Oil Refineries

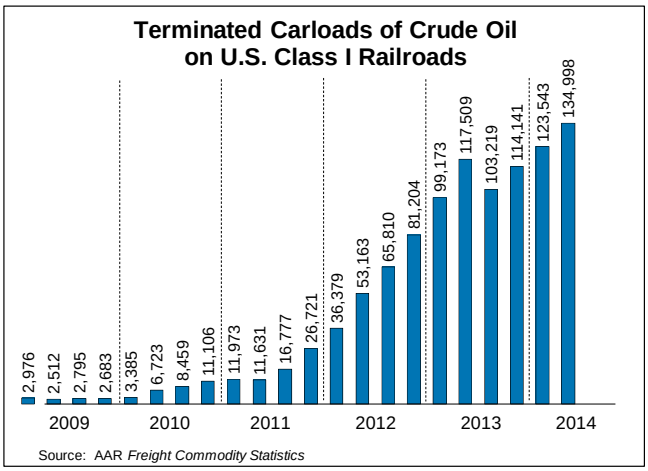


- Historically, most crude oil has been transported via pipelines. However, in places like North Dakota that have seen huge increases in crude oil production, the existing pipeline network lacks the capacity to handle the higher production. Railroads have the capacity and flexibility to fill this gap.
- Relatively small amounts of crude oil have long been transported by rail, but in recent years the increase in rail crude oil movements has been enormous. Originated carloads of crude oil on U.S. Class I railroads (including the U.S. Class I subsidiaries of Canadian railroads) rose from 9,500 in 2008 to 233,698 in 2012 to 407,761 in 2013. In the first half of 2014, they totaled 229,798, higher than in any previous six month period.
- Terminated rail carloads of crude oil on Class I railroads, which includes carloads that originated on a non-Class I railroad in the United States or on a railroad in Canada that then headed south, totaled 435,560 in 2013 and 258,541 in the first half of 2014.
- North Dakota, and the Bakken region more generally, have accounted for the vast majority of new rail crude oil originations. According to estimates from the North Dakota Pipeline Authority, around 750,000 barrels of crude oil per day were moving out of North Dakota by rail as of mid-2014, equivalent to more than 60 percent of North Dakota's crude oil production.
- There has clearly been significant growth in U.S. crude oil rail traffic, but one must be careful not to overstate crude oil's importance. Given that crude oil accounted for just 1.6 percent of total Class I originated carloads in the first half of 2014, it's not plausible to claim that crude oil has "crowded out" all other rail traffic.









- Assuming, for simplicity, that each rail tank car holds about 30,000 gallons (714 barrels) of crude oil, the 229,798 carloads of crude oil originated by U.S. Class I railroads in the first half of 2014 was equivalent to 900,000 barrels per day moving by rail. According to EIA data, total U.S. domestic crude oil production in the first half of 2014 was 8.2 million barrels per day, so the rail share was around 11 percent of the total.

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 a number of other advantages for transporting crude oil:

- Geographical flexibility. By serving almost every refinery in the United States and Canada, railroads offer market participants enormous flexibility to shift product quickly to different places in response to market needs and price opportunities. Railroads deliver crude oil to terminals not only in Louisiana and other places in the Gulf region, but also to the East Coast and the West Coast.

- Responsiveness. Rail facilities can almost always be built or expanded much more quickly than pipelines and refineries can be. Essentially, railroads are the only transportation mode that can invest in facilities quickly enough to keep up with production growth in the 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 ho w 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. These trains use dedicated equipment and generally follow direct shipping routes to and from facilities designed to load and unload them efficiently — say, from a gathering location near oil production areas to an unloading terminal at or near a refinery. A unit train might carry 85,000 barrels of oil and be loaded or unloaded in 24 hours.

- Underlying infrastructure. Over the past few years, railroads have invested hundreds of millions of dollars on tracks, locomotives, terminals, and more to enhance their ability to transport crude oil.

- Product purity. Consumers of crude oil often desire a specific type of crude oil. Shipping crude by rail allows "pure barrels" to be delivered to destination in ways that are not always possible with pipelines.

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 petroleum-related market long into the future.

Moving Crude Oil Safely

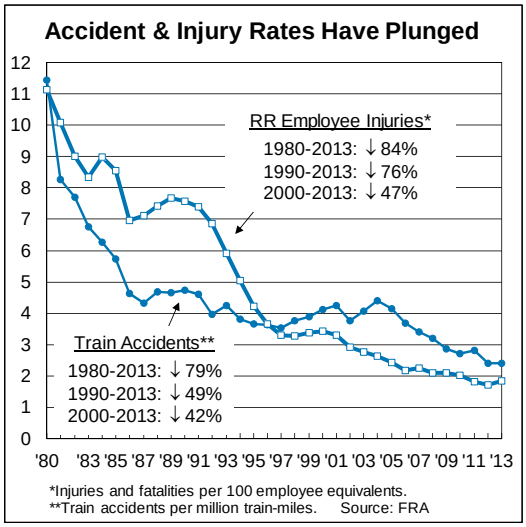
Railroads devote enormous resources to enhancing the safety of moving crude oil by rail. Rail actions in this regard fall into three broad categories: accident **prevention**, accident **mitigation**, and **emergency response**.

Accident Prevention

Railroads' overall safety record, as measured by Federal Railroad Administration (FRA) data, has been trending in the right direction for decades. In fact, based on the three most common rail safety measures, recent years have been the safest in rail history: the train accident rate in 2013 was down 79 percent from 1980 and down 42 percent from 2000; the employee injury rate was down 84 percent from 1980 and down 47 percent from 2000; and the grade crossing collision rate was down 81 percent from 1980 and down 42 percent from 2000.

Railroads are proud of these achievements, but they know the pursuit of safety never ends. The rail industry's goal is zero accidents, which is why railroads are always looking for ways to prevent accidents, including through the following means:

- Reinvestments. One of the most important ways railroads have reduced accidents is through **significant and consistent investments back into their networks**. Despite a weak economy, railroads have invested far more back into their networks over the past five years — nearly $115 billion — than in any five-year period in history. One of the major aims of these investments is to make the rail network more robust, so that the industry's decades-long record of declining accident rates continues. In fact, for many of these investments, improving safety is the primary reason the investments are made.



- Technological advancements. Railroads are constantly incorporating new technologies to improve rail safety, including sophisticated detectors along tracks that identify defects on passing rail cars; specialized inspection cars that identify defects in tracks and the ground underneath the tracks; and sophisticated systems that combine data from a variety of sources to produce "vehicle condition reports" on individual rail cars so that poorly performing cars can be identified before accidents occur. Many railroad-related technological advancements are developed at the Transportation Technology Center, Inc. in Pueblo, Colorado, a subsidiary of the Association of American Railroads that is widely considered to be the finest rail research facility in the world.

- Defect detectors. As of July 2014, specialized track side "hot box" detectors have been installed at least every 40 miles along routes with trains carrying 20 or more cars containing crude oil. These detectors help prevent accidents by measuring if wheel bearings are generating excessive heat and therefore are in the process of failing.

- Routing model. Several years ago, the rail industry and several federal agencies jointly developed the Rail Corridor Risk Management System (RCRMS), a sophisticated statistical routing model designed to help railroads analyze and identify the overall safest and most secure routes for transporting highly hazardous materials. The model uses a minimum of 27 risk factors — including hazmat volume, trip length, population density along the route, availability of alternate routes, and emergency response capability — to assess the overall safety and security of rail routes. Major U.S. railroads are now using the RCRMS for trains carrying at least 20 carloads of crude oil.

- Inspections. FRA regulations dictate the types and frequencies of inspections railroads must perform. The FRA-mandated inspection regime is comprehensive and thorough. New FRA regulations regarding inspections for internal rail defects became effective on March 25th. For main line tracks on which trains carrying at least 20 carloads of crude oil travel, railroads have agreed to perform at least one more internal rail inspection each calendar year than the new FRA regulations require. In addition, railroads will conduct at least two automated comprehensive track geometry inspections each year on main line routes over which trains with 20 or more loaded cars of crude oil are moving, something FRA regulations do not currently require.

- Speed restrictions. In August 2013, railroads self-imposed a 50-mph speed limit for trains carrying 20 or more carloads of crude oil. As of July 2014, if a train is carrying at least 20 cars of crude oil and at least one of those cars is an older "DOT-111" car (these cars are discussed further below), that train will travel no faster than 40 mph when travelling within one of the 46 nationwide "high threat urban areas" designated by the Department of Homeland Security.

- Train braking. As of April 1, 2014, trains operating on main line tracks carrying at least 20 carloads of crude oil have been equipped either with distributed power locomotives (i.e., locomotives placed in locations other than the front of the train) or with two-way telemetry end-of-train devices. These technologies allow train crews to apply emergency brakes simultaneously from both the head end and locations further back in the train in order to stop the train faster.

Accident Mitigation

In addition to their efforts to prevent accidents from occurring, railroads have taken, and continue to take, numerous steps to mitigate the consequences of accidents should they occur.

- Many of these mitigation efforts focus on increased federal tank car safety and design standards. The total North American tank car fleet consists of about 339,000 cars. Railroads themselves own less than 1 percent of these cars; nearly all are owned by rail customers and leasing companies. The dozens of distinct types of tank cars are differentiated by characteristics (pressure or general service, insulated or non-insulated, how much they can carry, and so on) that make them suitable or not suitable for carrying specific commodities.

- U.S. federal regulations pertaining to tank cars are set by the Pipeline and Hazardous Materials Safety Administration (PHMSA). Transport Canada performs a similar role in Canada. In addition, the AAR Tank Car Committee sets rail industry standards regarding how tank cars used in North America are designed and constructed.[1] These standards are often above and beyond federal standards.

- The rail industry has long supported increased tank car safety standards. For example, in March 2011, the AAR petitioned PHMSA to adopt more stringent requirements for new tank cars used to transport certain types of hazardous materials, including crude oil. These tougher standards called for more puncture resistance through the use of a thicker tank car shell or a jacket, extra protective half-height (at a minimum) "head shields" at both ends of tank cars, and additional protection for the fittings on the top of a car that enable access to the inside of the car.

[1] The AAR Tank Car Committee is comprised of railroads, rail car owners, rail car manufacturers, and rail hazmat customers, with active participation from the U.S. DOT, Transport Canada, and the National Transportation Safety Board (NTSB).

- In July 2011, after it had become clear that PHMSA adoption of the AAR's proposal was not imminent, the Tank Car Committee adopted what the AAR had proposed to PHMSA as the basis for new industry standards for tank cars used to carry ethanol or crude oil. The new standards, referred to as "CPC-1232," apply to new tank cars ordered after October 1, 2011. To date, around 24,000 tanks cars have been built to this tougher CPC-1232 standard.
- In November 2013, the rail industry called on PHMSA to adopt standards even more stringent than CPC-1232 for new tank cars used to transport crude oil and ethanol. In November 2013, railroads expressed support for requiring that new tank cars be equipped with jackets and thermal protection, full-height head shields, top fittings protections, and bottom outlet handles that will not open in a derailment.
- The November 2013 proposal also called for aggressively retrofitting or phasing out of tank cars used to transport crude oil or ethanol. The November 2013 proposal recognizes that input is needed from shippers and tank car manufacturers to determine the precise parameters of a phase-out program and to identify the retrofits that should be required.
- Since the November 2013 proposal, the rail industry has continued to evaluate what other standards might be appropriate to enhance the safety of tank cars used to transport crude oil. For example, railroads now support strengthening tank cars used to transport crude oil with thicker shells.
- Approximately 228,000 tank cars are so-called "DOT-111" general service tank cars. Around 100,000 DOT-111 cars are used to transport crude oil or other flammable liquids. To the extent that DOT-111 cars are used to transport crude oil, the rail industry believes they should be retrofitted or replaced as described above.
- Under federal regulations, the entity "offering" crude oil to the railroad for transport (e.g., the oil producer) is responsible for properly classifying the oil based on its level of hazard. On February 25, 2014, the FRA issued an executive order requiring that crude oil from the Bakken region be tested to ensure that it is properly classified before it is transported by rail. Railroads support the pursuit of proper classification and labeling of petroleum crude oil in tank cars by shippers prior to transport. This is essential to ensuring that first responders are able to safely and appropriately respond in the event of an accident.

<u>Emergency Response</u>

Railroads have extensive emergency response functions, which work in cooperation with federal, state and local governments, to assist communities in the event of an incident involving crude oil or other hazardous materials:

- Railroads' emergency response efforts begin internally:
  - ✓ All the major railroads have teams of full-time personnel whose primary focus is hazmat safety and emergency response, as well as teams of environmental, industrial hygiene, and medical professionals available at all times to provide assistance during hazmat incidents.

- ✓ Railroads also maintain networks of hazmat response contractors and environmental consultants, strategically located throughout their service areas, who can handle virtually any air, water, waste or public health issue. These contractors, who are on call at all times, have multiple offices and equipment storage locations and a vast array of monitoring equipment, containment booms, industrial pumps, and other spill response tools and equipment.
- ✓ Railroads have comprehensive "standard of care" protocols that ensure that impacts to the community — such as evacuations — are addressed promptly and professionally.

- Each year, railroads actively train well over 20,000 emergency responders throughout the country. This training ranges from general awareness training to much more in-depth offerings. The precise parameters of these emergency response training programs vary from railroad to railroad, but in general they consist of a combination of some or all of the following aspects:
  - ✓ Safety trains. Several railroads utilize "hazmat safety trains" and other training equipment that travel from community to community to allow for hands-on training for local first responders.
  - ✓ Training centers. Several railroads operate centralized hazmat training sites where they train employees, first responders, customers, and other railroad industry personnel in all aspects of dealing with hazmat incidents.
  - ✓ Local firehouse visits. In aggregate, railroads visit hundreds of local firehouses each year to provide classroom and face-to-face hazmat training.
  - ✓ Table top drills. Railroads regularly partner with local emergency responders to conduct simulations of emergency situations in which general problems and procedures in the context of an emergency scenario are discussed. The focus is on training and familiarization with roles, procedures, and responsibilities.
  - ✓ Self-study training courses. Railroads make available self-study programs for emergency responders that allow students to learn proper procedures at their own pace. Some railroads also provide related web-based training on hazmat and general rail safety issues.
- Railroads also support our nation's emergency response capability through the Security and Emergency Response Training Center (SERTC), a world-class facility in Pueblo, Colorado, that is operated by the Transportation Technology Center, Inc. (TTCI). Since its inception in 1985, SERTC has provided in-depth, realistic, hands-on hazmat emergency response training to more than 50,000 local, state, and tribal emergency responders and railroad, chemical, and petroleum industry employees from all over the country. Most of the training at SERTC is advanced training that builds on basic training responders receive elsewhere. Instructors at SERTC average more than 30 years of emergency response experience.
- Many railroads regularly provide funding to emergency responders in their service areas to attend SERTC. In addition, railroads have recently provided $5 million to develop a specialized crude-by-rail training and tuition assistance program for local first responders. The funds will be used to design a curriculum at TTCI specifically devoted to crude oil

emergency response, to provide tuition assistance for an estimated 1,500 first responders to attend TTCI for training, and to provide additional training to local emergency responders closer to home.

- For years, railroads have provided appropriate local authorities, upon request, with a list of the hazardous materials, including crude oil, transported through their communities. On May 7, 2014, the U.S. Department of Transportation issued an emergency order requiring railroads operating trains containing large amounts of Bakken crude oil to notify state emergency response commissions (SERCs) about these shipments. As noted above, railroads have for years worked with emergency responders and personnel to educate and inform them about the hazardous materials moving through their communities. These open and transparent communications will continue as railroads do all they can to comply with the emergency order.
- Railroads have developed an inventory of emergency response resources along their networks. This inventory includes locations for the staging of emergency response equipment and contact information. Railroads provided the DOT with this information and it is available upon request to emergency responders.
- Emergency responders have control of railroad accidents in which hazardous materials are spilled, but railroads provide the resources for mitigating the accident. Railroads also reimburse local emergency agencies for the costs of materials the agencies expend in their response efforts.

Conclusion

- North America is experiencing an unprecedented boom in crude oil production. Among many other benefits, this means North America is likely to move closer to energy self-sufficiency. Railroads are playing a critical role in this energy renaissance, with rail shipments of crude oil growing in recent years due to the flexibility and other advantages that moving crude oil by rail offers.