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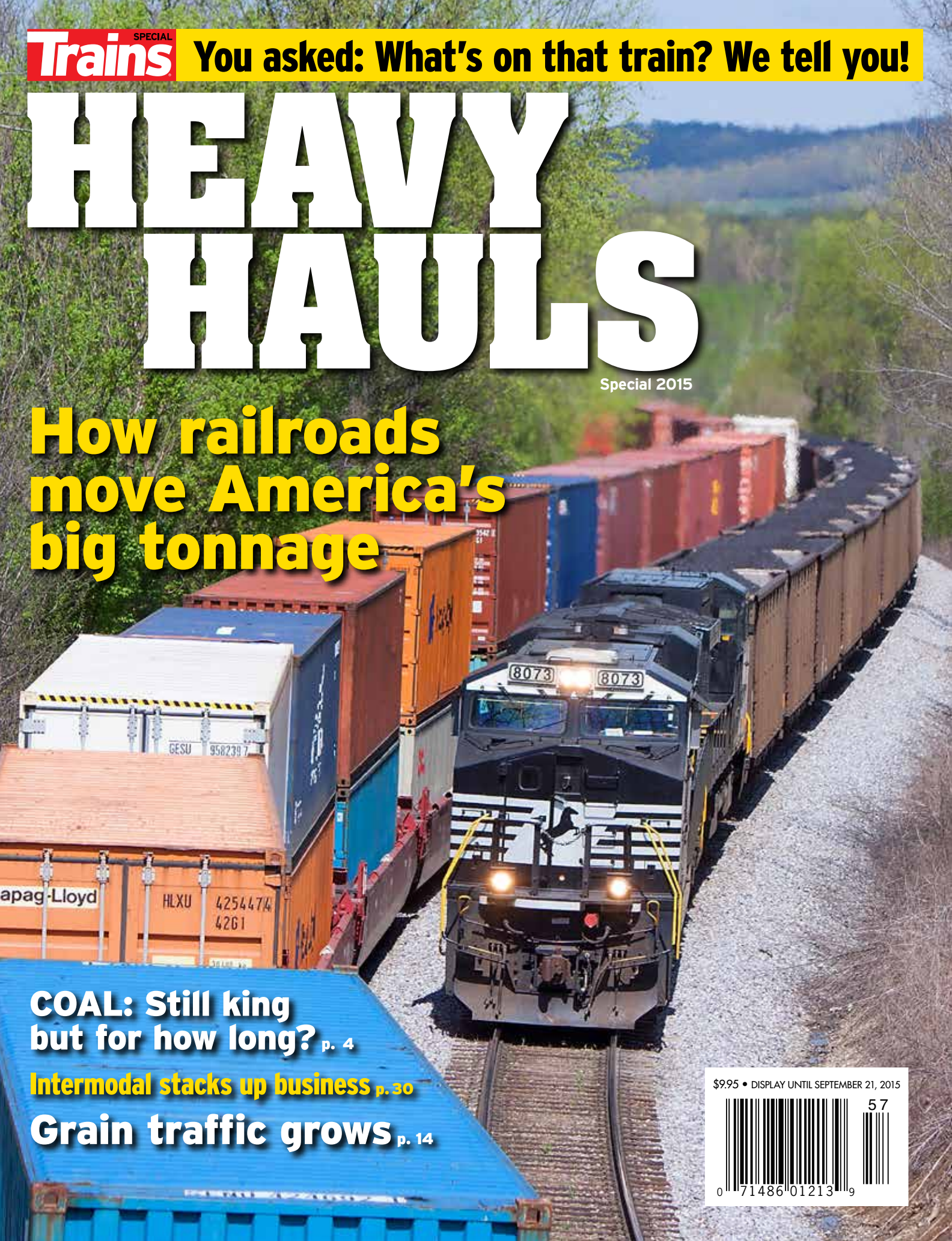

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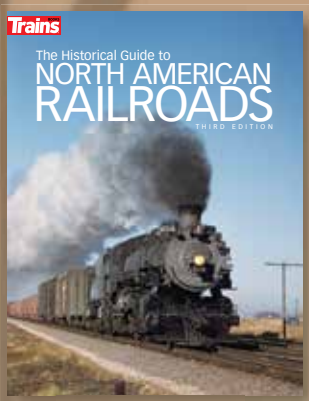

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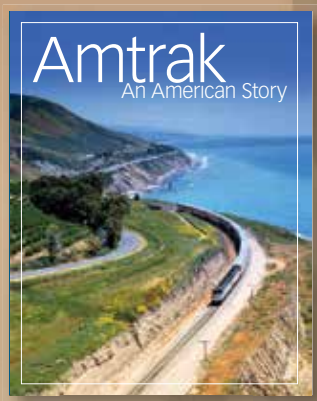

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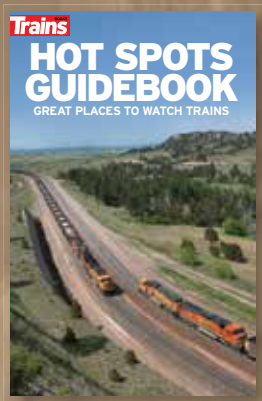

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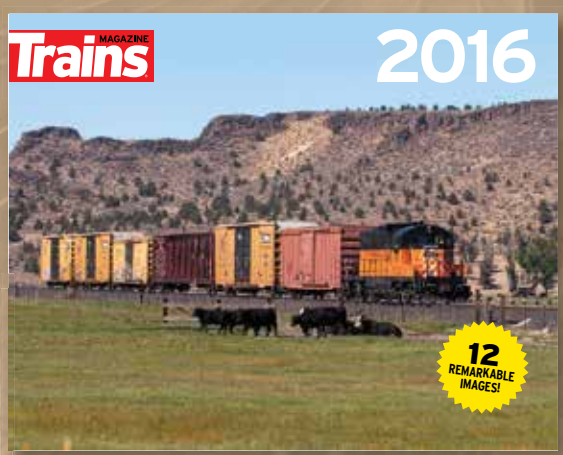

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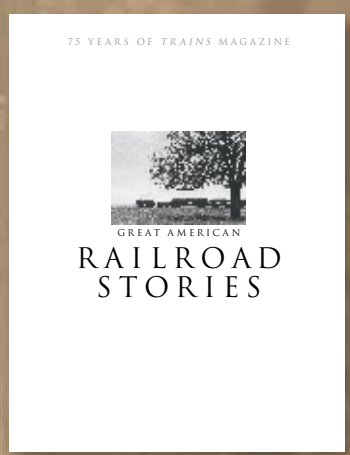

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BIG TRAINS FOR A BIG LAND

We get the question at Trains magazine all the time: What do railroads haul? The quick answer is, "a lot of things we use in our lives" and a smart-alecky retort, "what don't they haul?" The real answer is why we're presenting 100 pages to tell you what North American railroads haul and why and how they do it.

This is really an amazing tale. Most of the goods we use arrive by ship at West Coast ports, where trains pick up containers and take them to us. Most of the coal that is burned to generate electricity originates in lonely sections of Wyoming and moves by train to power plants in the East. Big trains travel hundreds, if not thousands, of miles to deliver across the continent.

Hauling heavy loads is what railroads do best. It's more efficient, better for the environment, and just plain exciting. At the risk of sounding like an ad for the Association of American Railroads, daily life wouldn't be possible without the industry.

It's not without problems — some significant. Chokepoints like Chicago complicate plans. Crude-oil trains have developed a nasty reputation over a short period of rapid growth. And railroads cannot build track or hire crews fast enough to meet the demand.

Enjoy this look at the big stuff that big trains carry across a big land, and marvel with us at the ingenuity of railroads.

editor@trainsmag.com

Editor Jim Wrinn is a big fan of heavy-hauling freight trains that crisscross the landscape every day. Casey Thomason

ON THE COVER: Norfolk Southern eastbound unit coal train No. 796 grinds up hill at Waddy, Ky., passing intermodal train 22A in the siding on the Louisville District. E.M. Bell

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COAL

BLACK DIAMONDS

Lifeblood of American railroading

by Tom Murray

No other commodity has had as great an impact on railroads as coal. This valuable fuel drove early railroad builders to hammer down strips of wood or iron across windswept plains or into dark hollers. Coal fed the fireboxes of railroading's fastest and most powerful steam locomotives, fueled the industry's greatest engineering achievements, and kept the balance sheets flush with cash.

Today, coal remains as the single most important commodity to the industry, representing 5.8 million annual carloads, or one in every five cars of freight. It meant 39.5 percent of tonnage, and approximately 19.9 percent of railroad revenues in 2013. Nearly 70 percent of coal delivered to power plants was delivered by rail. According to the U.S. Energy Information Administration, coal production was 984 million tons in 2013, down 3.2 percent from 2012's 1.02 billion tons and the lowest annual total since 1993. Despite this inevitable decline, due to competitive alternative energy options such as natural gas and tighter government regulations on power plant emissions, U.S. coal production remains an important commodity to the U.S. rail industry.

To meet Americans' insatiable hunger for electricity, the U.S. produces 90 percent more coal today than it did in 1970, but in that span, the business has changed dramatically. Then, more than 60 percent of America's coal came from the Appalachian region. Coal from Central or Western states was used close to where it was mined. For railroads, coal was a regional commodity, and single-line hauls were the rule. Now, Appalachian reserves are in decline, and the cost of extracting what's left has gone up. More than half the coal mined in the U.S. now comes from the West. The result? Much of the coal today crosses regional boundaries, and it's often carried by two or more railroads.

COAL-PRODUCING REGIONS IN THE U.S. AND CANADA

The largest coal-producing region in North America is the Powder River Basin in Wyoming and Montana. Known for its rich low-sulfur deposits, the Powder River Basin produced 407 million tons in 2013 through the region's 16 active surface mines. In Wyoming alone, 387 million tons of coal were produced in the Powder River Basin region. Eight of the nation's 10 largest mines are located here. Coal accounted for 96 percent of originating rail tonnage in 2012 in Wyoming. The Powder River Basin is categorized in the Western region of U.S. coal production. This region also includes Utah, Colorado, North Dakota, New Mexico, and Arizona. The Western region includes 52 active mines responsible for 530 million tons of production in 2013.

The second most significant coal-producing territory is the Appalachian region, which includes mines in Pennsylvania, Maryland, Virginia, West Virginia, Tennessee, Alabama, Ohio, and eastern Kentucky. This broad region is subdivided into the Southern, Central, and Northern Appalachia sectors. The Appalachian region accounted for nearly 270 million tons of coal production in 2013, through a total of 877 mines. In West Virginia, 115 millions tons of coal were produced, making the Mountain State the second-largest coal producer in the U.S. Like Wyoming, if it is leaving West Virginia by rail, it's probably coal: 93 percent of originating tonnage consisted of coal ship-

A Canadian Pacific hopper train rolls through Wardner, British Columbia, on Aug. 25, 2012. On the left is the northern part of Lake Koocanusa. Justin Franz

A train loads at West Virginia's Blacksville No. 2 mine in the Monongahela field, served by CSX and NS. Kenneth Lehman

ments to domestic and export customers.

Other coal-producing areas include a region defined as the Interior. This encompasses mines in Illinois, Indiana, Missouri, Texas, and Western Kentucky. This sector accounted for nearly 183 million tons of coal production in 2013, through a total of 103 active mines. The Illinois Basin, which extends from central Illinois to as far south as northwestern Tennessee, contributed more than 132 million tons of coal production as part of the Interior region.

WHERE DOES NORTH AMERICAN COAL GO?

U.S. coal consumption totaled 925 million tons in 2013, an increase of 4 percent from 2012's 889 million tons. The increased total was still 18 percent lower than the industry's peak in 2007 of 1.1 billion tons.

In 2013, 92.8 percent of coal consumption went to generate electricity. Texas, which not only produces coal, but also receives thousands of Powder River Basin coal trains each year, was the largest consumer of coal in 2013, at 103 million tons. Illinois, a significant player in the production of coal, consumed approximately 56 million tons in 2013, according to data collected by the U.S. Energy Information Administration.

Approximately 2.3 percent of U.S. coal consumption in 2013 was used to produce coke and 4.9 percent was used for other purposes, such as industrial uses in the steel, aluminum, and paper mill sectors. Undoubtedly, the success of the coal industry can be attributed largely to the electric-generation marketplace.

While U.S. electricity production had risen steadily over the past 60 years with only a few exceptions, electricity generation has decreased in four of the eight years since 2007, much of it due to the national economic recession that turned back the dial on industrial power consumption. In 2013, the increase in demand was only minimal. Coal remains as the primary fuel source for generating electricity in the U.S. In 2013, coal accounted for 39 percent of electricity generation, followed by natural gas at 27 percent. Other fuel sources included nuclear power, hydroelectric power, and renewable sources such as wind and solar.

In 2011, U.S. coal exports totaled 107 million short tons, the highest level in more than 20 years. Coal exports made up nearly 10 percent of total U.S. coal production, more than double the amount of coal exported in 2007, which included 55 million tons, or approximately 5 percent of total production. Exceptionally high export demand in countries such as India and China contributed to the increased percentage in overseas shipments. Interestingly, while the Powder River Basin is the top coal producer in the U.S., only 1 percent of its annual production was exported in 2011. In contrast, West Virginia, the nation's second-largest producer, exported 35 million tons of coal in 2011, nearly 27 percent of its total coal production from the year. The reasons are in the type of coal produced by each state and the proximity and connectivity of the state to international ports.

Meanwhile, imported coal has grown from less than 3 million tons a year before 1990 to more than 30 million tons annually, averaging about 3 percent of total U.S. consumption. Utilities in the Southeast import coal from Colombia (the largest supplier, with 77 percent of U.S. imports) and Venezuela. Indonesia is the second-largest source of imported coal.

Canada produced about 67 million tons in 2012, with 54 percent thermal and 46 percent metallurgical. About half of the country's output was exported, according to the Coal Association of Canada. Of the exports, 73.4 percent went to Asia, mostly from Alberta and British Columbia.

WHAT CRITERIA DO BUYERS USE WHEN CHOOSING COAL?

For the coal buyer, delivered cost (including transportation) is always the bottom line. But the range of coal types available for use at a specific plant is dictated by boiler design, engineering, and property specifications. For example, because it takes up to 1.5 times more Powder River coal than Appalachian coal to generate the same amount of electricity, a plant's stockpile, unloading tracks, and other features need to have enough capacity for the coal being used.

Another factor is sulfur content. Since the Clean Air Act of 1970, and following amendments passed in 1990, reducing sulfur dioxide emissions has been a key goal of coal users in the United States. The low sulfur content of Powder River Basin coal gave it a major advantage. Power plants have begun installing scrubbers that remove sulfur dioxide from plant emissions. This has begun to change the competitive relationship among coal-producing regions.

To best meet environmental and operating criteria, many utilities blend coal from different mines. Some, for example, will use a mix of Powder River Basin and Appalachian or Illinois coal to achieve a desired level of boiler efficiency and low-sulfur emissions, or to minimize ash deposits left after coal is burned. This blending can be done at the plant, or if it's served by water, at a river terminal where coal from different sources arrives by rail or truck.

Illinois stands to benefit from this changing landscape, notes coal industry consultant John T. Boyd, for three reasons: lower production costs versus Central Appalachia, the Illinois Basin's large contiguous reserves, and the expanding market for high-sulfur coal as more plants install scrubbers.

HOW DOES COAL MOVE FROM MINE TO CONSUMER?

According to the U.S. Energy Information Administration, approximately 68 percent of U.S. coal shipments were delivered to their final destinations by rail in 2013.

But the numbers have been slipping significantly as anyone can attest from the long strings of parked unit coal trains and rusty rails in eastern Kentucky, West Virginia, and southwest Virginia. According to the Association of American Railroads, coal accounts for approximately one in five freight railroad jobs. As recently as 2013, Class I railroads originated 5.95 million carloads of coal, nearly 23 percent fewer carloads than the 2008 peak of 7.71 million carloads. Class I railroads originated 693.8 million tons of coal in 2013, a reduction of 21 percent from the industry's 2008 peak.

Even though coal is off, it is still important traffic. Let's take a look at how different Class I railroads across the U.S. and Canada move coal from the mines to power plants, steel mills, or ports.

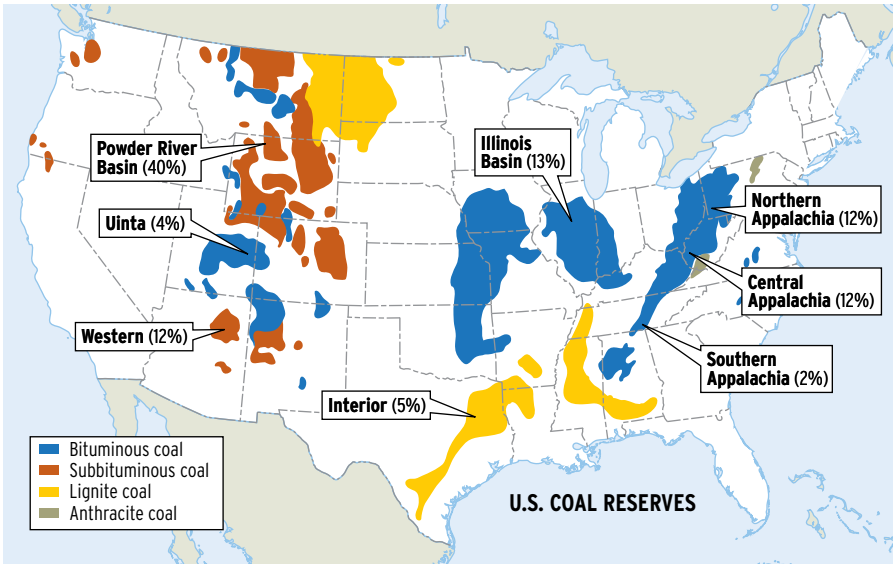
What are the differences between TYPES OF COAL?

Three major types of coal are mined in North America today:

• **Bituminous** has relatively high heating values (as measured in British thermal units, or Btu: the amount needed to raise the temperature of 1 pound of water by 1 degree Fahrenheit). Bituminous coal typically ranges between 11,000 and 14,000 Btu, with the highest-Btu coal often classified as metallurgical (*i.e.*, for use in steelmaking). Lower-Btu steam coal is used by electric generating stations and other manufacturing plants. The sulfur content of bituminous coal varies by region, with the Illinois Basin having some of the highest, and Uinta (Utah and western Colorado) and Central Appalachian regions some of the lowest. Bituminous coal is often found in seams only a few feet thick (the major seams in West Virginia, for example, are typically 4 to 6 feet), and much of it lies well underground. Eastern coal was traditionally extracted in underground mines, but surface mining has become more common recently. This shift has prompted several legal challenges stemming from environmental concerns, notably over techniques such as mountaintop mining.

• **Subbituminous** has lower heating values (8,300 to 11,000 Btu). Powder River Basin coal is almost entirely subbituminous, and owes its rapid growth in large part to its lower sulfur content, which helps utilities comply with environmental regulations. Coal in the PRB lies close to the surface and is found in giant seams averaging 40 to 100 feet thick, making it easy to mine in large quantities. Low-cost production, along with its lower Btu values, explains why PRB coal's per-ton market price is much lower than bituminous. However, those lower heating values mean it takes about 1.5 times as much subbituminous coal to generate an equivalent amount of heat as bituminous coal — which translates into more carloads for railroads that haul Powder River coal.

• **Lignite** has the lowest heating value of any coal (6,300 to 8,300 Btu). It is seldom transported far from where it is mined, and in fact most of the lignite in the United States is used in mine-mouth electric generating stations in Texas and North Dakota. Anthracite is a high-Btu coal that was widely used for heating in the 19th and early 20th centuries; today, it accounts for just one-tenth of 1 percent of U.S. coal production. — *Tom Murray*

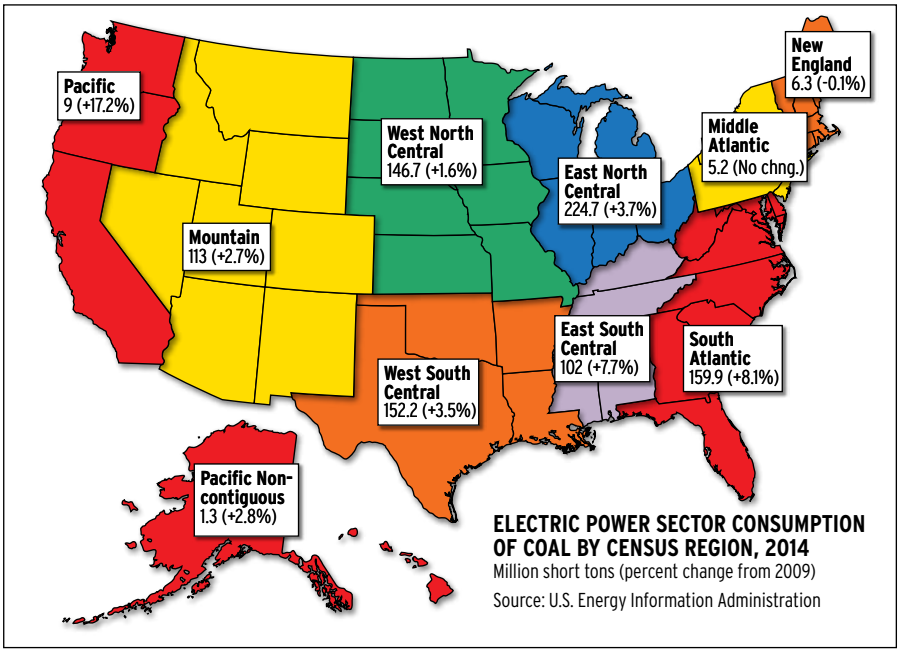


BNSF RAILWAY

BNSF Railway hauls more coal than any other North American railroad. In 2014, that came to 2.2 million carloads, up 3 percent from two years earlier. More than 90 percent came from the Powder River Basin. BNSF says it turns on the lights at one in 10 American homes. In the first quarter of 2015, the railroad handled 600,000 carloads of coal, up 7 percent from the same quarter in 2014. For all of 2014, coal revenues accounted for 22 percent of the company's business. Average revenue per carload of coal fell to $2,115 in the first quarter of 2015 from $2,174 in the first quarter of 2014.

As recently as 2008, total Powder River Basin volume totaled 275 million tons, of which 171 million tons came from mines

Ameren's Labadie, Mo., generating station, 35 miles from St. Louis, is one of the top 10 coal-fed power plants in the U.S. A UP train unloads there in 2007. TRAINS: Mike Yuhas and Ed Yuhas



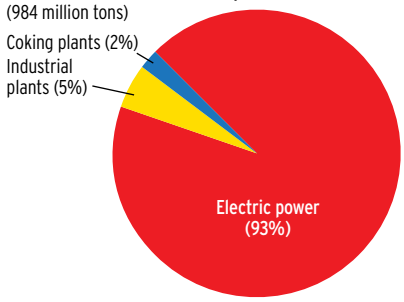
ELECTRIC POWER SECTOR CONSUMPTION OF COAL BY CENSUS REGION, 2014
Million short tons (percent change from 2009)
Source: U.S. Energy Information Administration

on the Joint Line it co-owns with Union Pacific south of Gillette, Wyo. The balance came from Powder River Basin mines in northern Wyoming and southwestern Montana served solely by BNSF.

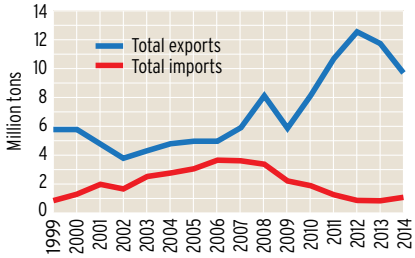
The railroad serves 15 mines in the Powder River Basin, four in Utah, three in New Mexico, and two in North Dakota. The Utah service is in cooperation with the Utah Railway. On an average day, 49 unit coal trains load out in the Powder River Basin, according to Surface Transportation Board filings.

Coal moves from these areas to a wide range of domestic and export customers. One of the railroad's critical coal-hauling routes extends from the Powder River Basin region, south into Colorado via the famous Joint Line and into the gulf region of Texas, serving multiple power stations along the route. Providing access to customers in the Midwest, the railroad also operates a highly trafficked coal route between the Powder River Basin south and east into Nebraska, Iowa, and Illinois. Additional coal is transported northwest from

U.S. COAL CONSUMPTION, 2013
(984 million tons)

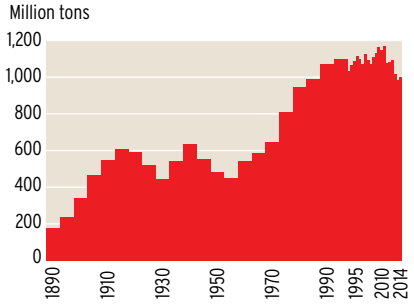


U.S. COAL EXPORTS AND IMPORTS, 1999-2014



Source: U.S. Department of Commerce, U.S. Energy Information Administration

TOTAL U.S. COAL PRODUCTION, 1890-2014
Million tons



Source: U.S. Energy Information Administration

the Powder River Basin to domestic customers in Washington and for export in British Columbia.

To accommodate the demands of Powder River Basin coal shipments and other commodities, BNSF launched a $6 billion capital plan in early 2015, aimed at increasing capacity in key corridors, including highly trafficked coal routes. In the railroad's Central Region, it allocated $650 million across six states for engineering maintenance and expansion projects, including the completion of two new sidings and a siding extension on the Hannibal Subdivision in western Illinois; construction of two double-track segments of the Ravenna Subdivision in Nebraska, and a siding extension on the Brush Subdivision east of Denver.

Operating changes improved coal's financial contribution. BNSF's maximum train size out of the Powder River Basin is now 150 cars, and the average payload per car is 117 tons, meaning the longest trains carry more than 17,000 tons. But train length depends on many factors, including track configuration at the destination, helper districts, siding capacity, and the willingness of connections to take distributed power.

BNSF's hopper car fleet consists of approximately 80 percent customer-supplied cars and 20 percent railroad-owned equipment. The utility cars are overwhelmingly aluminum-bodied, but some steel cars are in service to cement plants and other industrial users. The company cars carry a maximum of 121 tons of payload. Trains move with distributed-power locomotives, usually two up front and one on the rear.

The big billboard at Cabin Creek, W.Va., echoes the sentiments of many in the Mountain State, the East's big coal producer, as CSX loads roll east on Jan. 22, 2005. Scott Lothes

A wisp of dust materializes as coal pours into another Powder River Basin unit train. Mines have changed their loading patterns to mitigate coal dust flying off cars and settling on railroad tracks. Typical loaded unit coal trains weigh in at 15,000 tons. TRAINS: Mike Yuhas

UNION PACIFIC

Union Pacific trails BNSF only slightly in the size of its coal franchise. The railroad hauled 1.7 million cars in 2013, down from 1.8 million the year before. Average revenue per car for coal was $2,336, up from $2,092 in 2012. Coal and coke were the second biggest contributors to UP's 2013 freight revenues at 19 percent, or $4 billion, coming in behind intermodal at 20 percent.

In the first quarter of 2015, coal revenues were off, driven by a mild winter, low natural gas prices, and soft export demand.

UP's coal volume declined 9 percent between 2012 and 2013, with half of the loss attributed to losing a service contract. That, along with a mild summer and efforts at major utility plants to manage stockpiles, cut into UP's overall 2013 coal traffic. The railroad also said it faced production issues at mines in Colorado and Utah. Exports to Europe and Asia remained the same between 2012 and 2013 at about 8 million tons.

The southern Powder River Basin is UP's chief coal country, accounting for 73 percent of traffic. The railroad serves 11 mines there, and on an average day, 16 unit coal trains are filled, according to the Surface Transportation Board. The Uinta Basin region of Colorado and Utah is the second-largest source of coal volume, representing 14 percent of tonnage in 2013. The rest came from smaller producers or interchange traffic.

UP anticipates that coal traffic could decline further in the coming years as more power plants close or reduce their use of coal. According to a statement by Vice President and General Manager-Coal Doug Glass in UP's 2013 Fact Book, a slip of 10 million tons is possible over the next four to five years. At the same time, Glass commented that, "We believe our export volumes could double from around 8 million tons in 2013 to 16 million tons by 2017." If that happens, it would flow from UP-served mines to West Coast, Gulf of Mexico, Mississippi River, and Mexican ports.

He also went on to say that UP could see a boost by offering low-sulfur coal to more power plants in the Eastern U.S. Most of the coal on UP goes to Southern states, including Texas, 37 percent, and Midwestern states, which account for 29 percent.

Although Union Pacific doesn't reach as many Powder River mines as BNSF does, it

Second to BNSF in coal volumes, Union Pacific, shown here descending the Rockies at Clay siding on the famous Big Ten Curve near Denver, relies on distributed power to move its coal. Two units are up front, three are mid-train, and one is on the rear. Chip Sherman

North America's top coal hauler is BNSF Railway, which ran this train at Sully Springs, N.D., on Aug. 3, 2009. Robert W. Scott

serves a wider variety of coal shippers outside the Powder River Basin, notably 10 mines in Utah and Colorado, three load-outs in the Illinois Basin, and five mines along its main line in southern Wyoming.

The cars that UP uses for coal service differ by loading region. In the Powder River Basin, 98 percent are high-capacity cars (286,000 pounds on rail), almost all of them aluminum. The other 2 percent are primarily steel, with a gross weight on rail of 268,000 pounds. The fleet is 95 percent customer-controlled. The 5 percent owned by the railroad is used mainly for smaller utilities or industrial customers that don't ship in large volumes.

In the Colorado/Utah region, the equipment mix is 80 percent 286 cars, 20 percent 268s. Roughly two-thirds are railroad-owned — a high percentage. The reason for this, the railroad says, is that many buyers of coal from this region are industrial users with non-repetitive movements, and owning equipment gives UP the ability to shift cars from one mine to another as customer requirements change.

Distributed power is a mainstay of UP's coal trains. Configurations out of the Powder River tend to be either two-by-one (two units on the head end, one DPU on the rear) or two-by-two. Many of the two-by-two trains have their second DPU removed at South Morrill, Neb., and continue east in two-by-one mode. Average train size from the Powder River Basin is currently 132 cars, with a maximum of 142 on trains destined for the St. Louis corridor.

Colorado and Utah trains that move east through the Moffat Tunnel are generally configured as two-by-two-by-two (two

A southbound CSX unit coal train passes a stopped empty hopper train at Fordtown, Tenn., on the railroad's Kingsport Subdivision on Nov. 20, 2014. Jeremy J. Schrader

head-end, two mid-train, two rear). At Denver, the mid-train power and one of the rear units are removed, and trains continue in two-by-one mode. The average size of these trains is 103 cars, but as on the other big railroads, UP expects train lengths to keep growing.

CSX TRANSPORTATION

In contrast to western Class I railroads, CSX Transportation serves a number of small and medium mining operations, as well as large facilities, with well more than 100 loadouts in nine states. Serving as the largest coal transporter east of the Mississippi River, the Jacksonville, Fla.-based railroad transports coal to a wide range of domestic and international customers, primarily from its Appalachian and Illinois production regions.

The railroad's Huntington Division includes multiple coal branches and mainline routes from predecessor roads such as the Baltimore & Ohio, Chesapeake & Ohio, and Clinchfield Railroad. In West Virginia, along the railroad's former C&O main line, CSX serves several loadouts on five different branch lines that extend from near Huntington to Hinton. In eastern Kentucky and southwestern Virginia, a handful of mining operations dot the Big Sandy Subdivision, and the former Clinchfield Railroad between Elkhorn City, Ky. and Spartanburg, S.C., serves as a direct coal route to domestic utility customers in the states of North Carolina, South Carolina, Georgia, and Florida.

On the railroad's Baltimore Division in north central and northeastern West Virginia, several loadouts that feed into the railroad's former B&O yard at Grafton provide relatively direct access to eastern coastal ports at Baltimore.

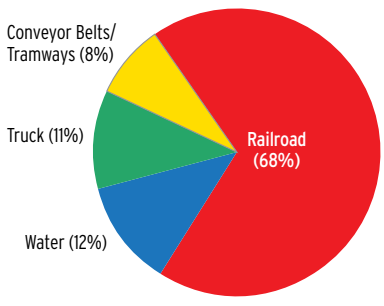
CSX delivers eastern export coal to terminals at Baltimore and Newport News, Va., river terminals and Great Lakes docks (Ashtabula and Toledo, Ohio), which handle coal for utilities, steelmakers, and other industrial users along the inland waterway system. CSX also moves export coal from Alabama mines to the Port of Mobile.

According to the railroad's fourth quarter review in 2014, domestic utility coal and domestic coke, iron ore, and other accounted for 74 percent of coal tonnage for the quarter, with export metallurgical coal accounting for 16 percent and export thermal coal accounting for the remaining 10 percent. Recent declines in international shipments of thermal coal have been attributed to global market conditions, while metallurgical coal volumes showed a slight boost due to increased demand for cheaper, higher-volatility coals for steel and industrial production.

The downsizing of many coal production sites in southern West Virginia and eastern Kentucky, as well as increased regulations on East Coast power plants have impacted the coal mining industry in this region — much of it former Chesapeake & Ohio and Louisville & Nashville territory. For the full year 2014, the railroad reported

HOW DOES COAL MOVE?

Railroads moved more than two-thirds of U.S. coal produced in 2014



Running beneath classic Norfolk & Western color position light signals in the heart of coal country, a Norfolk Southern unit coal train rolls through Maybeury, W.Va. Samuel Phillips

Returning from Roberts Bank, a CN train passes Jasper, Alta., on its 689-mile run to the Cheviot mine in 2009. The railroad hauls an average of 45 million tons each year. Tim Stevens

a 6-percent increase in volume and a 2-percent decline in revenue, with the additional shipments attributed in part to re-supplying utility stockpiles, though the overall market remained challenged by low natural gas prices and environmental regulations. Overall, CSX says it expects 2015 domestic coal volumes to be off 5 percent.

Despite challenges within the coal industry, CSX continues to invest in key coal routes and equipment, consistent with market levels. The company has acquired more than 175 General Electric 4,400-hp A.C. locomotives since 2011, and some of those heavy-tonnage locomotives are assigned to coal service on the railroad's Huntington and Baltimore divisions. CSX has focused on developing high-adhesion locomotives specifically for use in coal traffic. CSX has implemented additional efficiency initiatives that include increases in train size and the use of stainless steel and aluminum rebuilt CSX coal cars. CSX has also been expanding track capacity to support growing coal volumes from the Illinois Basin and Northern Appalachia.

NORFOLK SOUTHERN

Another prominent player in the transport of coal in the East is Norfolk Southern, which operates a fleet of more than 23,000 hopper cars to serve transload facilities in Maryland, Kentucky, Ohio, Pennsylvania, Virginia, and West Virginia.

Much like CSX, Norfolk Southern serves small mining operations throughout eastern Kentucky, West Virginia, and Virginia as part of the railroad's Pocahontas Division. The former Norfolk & Western territory serves as one of the key coal routes for the railroad today, primarily serving domestic utility companies in the Midwest and South, as well as international customers via its Lamberts Point Coal Terminal in Norfolk, Va. The heart of the port terminal is Pier 6, the largest and fastest coal-exporting facility in the Northern Hemisphere.

Also similar to CSX, Norfolk Southern has been impacted by reduced production in the Appalachian coal region. In the fourth quarter of 2014, the railroad reported coal revenues of $543 million, 15 percent lower when compared to the fourth quarter of 2013, and attributable to a weakening global market and fewer utility shipments. Volumes decreased by 6 percent in the same period. The railroad's 2014 summary reported total coal revenue of $2.4 billion, down 6 percent, as a result of a 5 percent volume decline when compared to 2013. While domestic shipments have decreased, international shipments via Lamberts Point have helped offset the decrease in demand.

In 2014, Pier 6 handled 16.8 million tons of coal, or approximately 17 percent of the nation's total amount of export coal for the year. When combined with the railroad's Baltimore port, which accounted for an additional 6.3 million tons, the railroad handled nearly 24 percent of the total U.S. coal exports in 2014. Approximately 74 percent of the tonnage moved was metallurgical coal, destined for steel plants across Europe, Asia, South America, and the Middle East.

Coal made up 21 percent of the railroad's $11.6 billion operating revenues in 2014. Utility coal accounted for 66 percent of coal shipments in 2014, or approximately 93.8 million tons. Export coal accounted for 16 percent at 23.2 million tons. Additionally, domestic metallurgical coal made up 11 percent at 16.1 million tons. Industrial coal contributed 6 percent at 8.6 million tons in 2014.

Notable coal-producing areas on Norfolk Southern lines are found in Pennsylvania, West Virginia, and southwest Virginia. The former Monongahela Railway near Brownsville, Pa., is rich with loadouts and sees numerous unit coal trains each day that head to power plants as far away as Wisconsin. Another strong area for coal production is the former N&W branch to the Grundy, Va., area near the Kentucky border.

CANADIAN NATIONAL

In 2014, Canadian National reported higher fourth quarter coal revenues, thanks to U.S. utility demands. Executive Vice President JJ Ruest stated in a fourth quarter conference call that U.S. coal revenue was a bright spot for the railroad, up 35 percent at the end of 2014 as a result of utility demand and new coal services, including a metallurgical coal-blending operation.

With access to more than 13 mines and seven petroleum-producing facilities in the U.S. and Canada, the railroad handles an average of 45 million tons of coal each year, delivering shipments to both U.S. utilities and offshore markets, via west coast ports and the U.S. Gulf export facilities.

While revenues did decrease slightly per the railroad's 2013 annual report, the railroad serves two mining regions with the potential for growth: northern British Columbia (thanks to its 2004 acquisition of BC Rail) and the Illinois Basin (from its 1999 purchase of Illinois Central).

Approximately 49 percent of Canadian National's coal and coke business came from Canada, with the bulk going to Vancouver and Prince Rupert, B.C., for export. The other 51 percent was U.S. business, about a quarter of it Powder River Basin coal received from connections. Most U.S. shipments went to utilities in Michigan, Kentucky, Illinois, and Wisconsin, and to the U.S. Southeast from the Illinois Basin with connecting carriers.

Canadian National serves five coal-loading facilities in Illinois, and nine load-outs in Canada. Spokesman Mark Hallman says 72 percent of the tonnage originated from CN-served mines came from the U.S., and 28 percent from Canada. About 31 percent of CN's coal tonnage moved to river or lake terminals. He says 99 percent of Canadian National coal traffic moves via unit trains that range in size from 100 cars to 155 cars, with distributed power units used on trains more than 122 cars. Typically, trains originating at Canadian mines will be a minimum of 112 cars. "However," Hallman says, "We have had good success with some origins running at 150 cars. In the U.S., train lengths will vary, but typically we strive for 135 cars per train."

Hallman listed Canadian National's longest-distance coal movements as follows, from longest to shortest:

- Winniandy, Alta. (Grande Cache mine), to Thunder Bay, Ont. (1,539 miles)
- Coal Valley, Alta., to Prince Rupert, B.C. (864 miles)
- Luscar, Alta. (Cheviot mine), to Roberts Bank, B.C. (689 miles)
- Winniandy (Grande Cache), to Roberts Bank (678 miles)
- Dial, Ill., to Convent, La. (653 miles)
- Galatia, Ill., to Mobile, Ala. (642 miles)

The primary export coal pier on the West Coast is Roberts Bank, near Vancouver, B.C., where a CP train with mid-train distributed power arrives on March 22, 2008. David Honan

CANADIAN PACIFIC

In 2014, coal accounted for 10 percent of annual revenue, the same percentage as 2013. Coal business consists primarily of metallurgical coal transported from southeastern British Columbia to the ports of Vancouver and Thunder Bay and to the U.S. Midwest. In the U.S., coal business consists of thermal coal and petroleum coke shipments within the U.S., or for export through Pacific ports. In 2014, coal revenue was $621 million, a decline of $6 million, or 1 percent, from 2013, attributed to a drop in shipments of U.S. thermal coal, partially offset by a rise in metallurgical coal shipments and increased rates.

Teck Resources Ltd. coal originates at five mines in southeastern British Columbia. Most of it is metallurgical coal, delivered to Vancouver for overseas steelmaking. Some also goes east to Thunder Bay (a distance of 1,300 miles) to be shipped to steel producers along the Great Lakes, and some travels to Chicago-area steel plants (a 1,700-mile move).

On CP, the standard Teck train set for Vancouver makes the steep climb through the Selkirk Mountains and over Rogers Pass with 152 aluminum cars, and with two-by-one-by-one distributed power, says Shelly Reid, CP's national account manager for coal, up from the previous model of 129 cars. Investments in the mine loadouts, rail sidings, and ports, along with process changes, have been implemented over the past four years to support these longer, higher-tonnage trains. Additionally, remote loading technology has been implemented at Teck Resources' Fording River mine, where the mine loadout operator controls the train with software during the loading process. Once the train is loaded, the CP crew takes control of the train again.

All loads are profiled and treated with an environmentally benign glue-like product at the mines, and again mid-route, as the trains travel from southeastern British Columbia to Vancouver. Additionally, a side-release product is used in winter months to maximize coal release during train dumping. All empty railcars are sprayed again before leaving the ports.

CP's Thunder Bay and Chicago trains continue to operate with primarily steel equipment on account of the configuration of the car dumpers, and in case the coal needs to be thawed on arrival in winter. Most cars in British Columbia coal service are owned by CP, but some are owned by Teck. CP's U.S. coal activity consists of delivering or forwarding unit trains received from other carriers to on-line power plants, mainly in the U.S. Midwest.

KANSAS CITY SOUTHERN

At connections in Kansas City, Mo., Kansas City Southern receives unit trains of Powder River coal from BNSF and UP to deliver to eight on-line power plants. KCS also hauls Illinois coal in merchandise freights for industrial customers, and petroleum coke from U.S. refineries to cement plants in Mexico or its export terminal at Port Arthur, Texas. All totaled, 80 percent of KCS's coal revenues came from unit trains, which can number about 10 a day (loads and empties) on its Kansas City-Shreveport, La., spine.

As you see, there's nothing simple about the coal business, but railroads are the key component in moving black diamonds. T

TOM MURRAY held operating and marketing positions with CSX, Soo Line, and Southern Pacific. CHASE GUNNOE and JIM WRINN updated the report.

GRAIN

YOUR NEXT

Somewhere between the amber waves of grain and 'part of this complete breakfast,' there's a train of covered hoppers, moving the bounty of the land

by Michael W. Blaszak

Giant canisters on flanged wheels, hatches open in the searing sun, receiving a torrent of golden kernels as they are pushed by an elderly switch engine in the confines of a grain elevator. Manifest freights, heavy with gray, brown, and green covered hoppers, truck springs compressed under the weight of their loads. Symmetrical unit trains filled exclusively with corn, wheat, soybeans, or ethanol, thundering up ruling grades behind the newest locomotives, rushing to deliver their lading to processors or oceangoing ships in order to begin the cycle anew.

This is how the transportation of grain and other agricultural products by rail in North America might look to the trackside observer. Yet there's much more to this steel river of grain that can't be seen from the right-of-way. Which crops are grown and how and where they are shipped is determined by a complex interaction of economic and political factors involving many players — farmers, truckers, elevator operators, grain marketing companies, railroads, and ocean carriers, as well as local, national, and foreign governments — with each group pursuing its own interests.

Climate, soil conditions, fertilizer costs, market value, and government policies all influence grain production and oil-producing crops like soybeans (which, though not grain, are included in the scope of this article). The resulting market volatility has been a blessing and a curse to railroads whose fortunes are tied to the bounty of the land. The potential for profits is huge, but the business could evaporate overnight in the violent fury of a dust storm or the quiet power of a politician's pen.

In the United States, the federal government has been providing financial support to agriculture for decades, serving as a lender of last resort and paying farmers not to grow crops in an effort to boost prices. Congress passed the Federal Agriculture Improvement and Reform Act (or "Freedom to Farm Act") in 1996 with the intention of phasing out direct farm subsidies over a seven-year period, but as crop prices declined in subsequent years, the government continued to pay disguised subsidies in the form of enhanced transition payments. When the transition period expired in 2002, Congress enacted a farm bill re-

A CSX Transportation grain train heads north at sunset near Deshler, Ohio, on June 13, 2011. Brian Schmidt

MEAL starts here

storing the subsidies. The Agricultural Act of 2014 took another stab at eliminating direct payments to farmers by increasing reliance on insurance programs; that legislation is currently being implemented. Other nations, including the European Union, subsidize their farmers as well. These subsidies and other trade barriers, such as bans on genetically modified plants, which are commonly grown on U.S. farms, distort cultivation and marketing patterns across the world, restricting North American grain from some markets and sometimes resulting in overproduction at home.

GRAIN AND THE RAILROADS

Since the Baltimore & Ohio began hauling flour from Ellicott's Mills, Md., to Baltimore in 1830, agricultural products have been an important component of railroad business plans. Early rail transportation greatly increased market options for farmers in settled parts of the country and enabled agrarian development of the Great Plains after the Civil War.

Though seemingly eclipsed in prominence by coal, oil, and intermodal traffic, grain still represents a substantial share of the rail industry's 21st century traffic mix. Overall, railroads originated about 28 percent of all U.S. grain shipments in 2011, the latest figure available. In 2013, shipments of grain accounted for 4.6 percent of carloads and 7.1 percent of revenue tonnage originated by the seven Class I railroads in the U.S., according to Association of American Railroads statistics. Though final numbers haven't been published yet, record corn and soybean harvests pushed grain shipments substantially higher in 2014, and two months into 2015 rail traffic is rising even more, as stored crops move to market.

Where agricultural traffic shines, though, is in the revenue it earns. According to the AAR, that 4.6 percent of loads generates about 6.5 percent of the carriers' total revenue. Over the past 20 years, short-haul grain shipments (up to 500 miles) have increasingly shifted to trucks, while the length of haul (and therefore revenue per load) of rail shipments has increased dramatically, more than doubling for soybeans. Longer hauls generally earn the railroads more money. Railroads also have succeeded in raising grain rates and collecting surcharges to recover fuel costs when the price of diesel rises.

The carriers don't publicly report the profitability of each segment of their traffic portfolios, but it's safe to conclude that none of the Big Seven is losing money on its grain business. BNSF, which hauls more grain than any other railroad, said in February 2014 that "agriculture products will continue to be a vibrant growth industry and we are investing and expanding capacity to support that growth."

Some major railroads have expanded their grain franchises by purchasing shorter rail lines that are supported largely by farm shipments. Perhaps the biggest Class I railroad bet on grain has been Canadian Pacific's 2008 purchase of Dakota, Minnesota & Eastern for $1.48 billion. In its successful 2012 campaign to oust CP's incumbent directors, Pershing Square Capital Management argued that the railroad had overpaid for this asset. Nonetheless, after CP installed

In 2007, the U.S. lifted tariffs on corn shipments to Mexico, which benefitted this Kansas City Southern train at Mooringsport, La. David Hoge

new leadership, the company hung on to the eastern portion of DM&E, which feeds a steady flow of corn, wheat, and ethanol shipments to the rest of the system. DM&E's sparsely trafficked western part was sold to Genesee & Wyoming in 2014 and now operates as the Rapid City, Pierre & Eastern.

BIG BUSINESS, BIG TRAINS

One reason railroads are making a success of their grain traffic is that they are hauling it more efficiently. The historic image of a diesel road-switcher trundling down a 10-mph branch line with 20 covered hoppers in tow to switch out country elevators is no longer the norm, owing to changes driven by competition.

A farmer harvesting a crop wants to sell it to the highest bidder. This may be an industrial user, such as a flour mill or a soybean crusher, or a dealer operating a storage facility like a grain elevator. The farmer may sell immediately after harvesting, or store some or all of the crop waiting for a better deal. Different grains of the same type and grade are generally fungible, and buyers will seek out the lowest delivered price, regardless of who the seller might be. Since transportation is a big part of that price, the cheaper the grain moves to the buyer, the more the buyer can pay the farmer.

Railroad costs, in turn, depend largely on investment. Tracks, cars, and locomotives cost money to buy and maintain. The more efficient their use, the lower the unit cost of handling each load, making the railroad more competitive. However, traditional carload service did not enable railroads to optimize the use of their assets. Even when moving multiple-car shipments in manifest freight trains, railroads were fortunate to load each car once a month, because cars had to be switched at every junction, and often missed connections. Railroads knew how to wring more productivity out of their equipment: Run dedicated unit trains from origin to destination and back again without switching, like they did for their coal-consuming electric utility customers. But the average elevator didn't handle enough grain or have enough track space to load train-length shipments.

Burlington Northern adopted pricing and operating policies during the 1990s to evolve grain transportation toward the unit-train model. After buying thousands of new 286,000-pound covered hoppers capable of carrying 110 tons of grain — 10 percent more than the previous 100-ton standard — BN offered customers discounts for shipping trainload quantities in the new cars and for loading and releasing empty cars quickly. Running in solid trains BN called "shuttles," the new cars were able to make more turns which, combined with a strong export market, enabled BN to post an all-time record for grain volume in August 1995, a month before the Santa Fe merger.

Successor BNSF Railway continued the shuttle train program, giving its lowest rates to shippers that could load a 110-car train for a single destination in 15 hours. Other railroads followed suit, though conditions such as train length and loading time vary by carrier. Since the advent of shuttles, some 300 elevators have invested millions in additional track and grain-handling capacity to meet BNSF's shuttle rate performance requirements and improve their competitive position as grain merchants.

Shuttles increase car velocity to as many as three round trips a month between Midwestern origins and Pacific Northwest destinations, and up to eight turns a month on shorter routes, enabling railroads to minimize their investment in locomotives and cars while maximizing production.

To pay off their investment in increased loading capacity, shuttle loaders must push more grain through their facilities. Typically, they share some of their transportation savings with the farmers by paying them more for grain. This places non-shuttle elevators at a disadvantage, as grain trucks

Grain pours into a covered hopper at an elevator in Snyder, Okla. Harold L. Miller

drive right by on their way to shuttle train loadouts. Increasingly, non-shuttle elevators that aren't within trucking distance of ports or end-users are going out of business, unable to compete. A few states have implemented programs to aid these smaller elevators, with the state of Washington going so far as to buy the 300-mile Palouse River & Coulee City from Watco in 2007 in order to preserve rail service.

Another barrier to increasing productivity was the historic volatility of grain traffic. Poor harvests and low market prices depressed grain shipments, resulting in idle cars and locomotives that weren't earning their keep. Conversely, the railroads couldn't supply enough cars in times of high demand. To spread some of this risk to its customers, BN initiated its Certificates of Transportation program in 1988. Under this scheme, a shipper can purchase the right to load covered hoppers with a given commodity for a particular destination at a specific future time. If its needs change, the shipper can sell that right to another customer who needs the capacity, and if no one uses the equipment, BN earns something to cover its cost to own the unused cars. Grain shippers balked initially, but after BN's COTS tariff survived legal challenges, other railroads initiated similar programs, and they are now entrenched.

THE STRUGGLE OVER RATES

While squeezing transportation costs helps the bottom line, the railroad industry's current financial success in the grain business can be attributed largely to rising rates. The carriers in recent years have found themselves in the fortunate position of being able to charge more for moving grain, and to make those rate increases stick.

In a free enterprise economy, competition is supposed to limit price increases. Railroads face competition for grain movements where hauls to customers are short, making trucks more productive, and where rivers are open to navigation. Barge rates are generally lower than rail rates, though this advantage may be offset by the cost of moving grain to a river terminal. Barges operate up and down the Mississippi River from St. Paul to New Orleans, and they venture up the Missouri River as far as Sioux City, Iowa, the Arkansas River to Tulsa, Okla. (Port of Catoosa), and the Ohio River to the Pittsburgh area. A primary market for barge transportation in this area is corn bound for export. In addition, the Tennessee-Tombigbee Waterway system reaches points in the Southeast, and barges ply the Columbia River in the Pacific Northwest.

Railroad rates in the Mississippi Valley and the South are held down to some extent because of this competition, and complaints from grain shippers are relatively

GRAINS THAT MOVE BY RAIL:
What we're growing, and where it goes

CORN

Native to the Americas, corn has become the world's largest crop by weight of annual production. More than 30 percent of the world's corn is grown in the U.S., the largest producer. Corn is cultivated across the nation, but the most prolific states are in the Midwestern corn belt stretching from Indiana to Nebraska. About 45 percent of U.S. production is used to feed animals, moving from the corn belt to cattle feedlots in the Southwest, poultry producers in the South, and dairy farms across the nation. About 40 percent of the record U.S. corn crop of more than 13.9 billion bushels for 2013 was made into ethanol, while about 15 percent became food products such as corn starch and high-fructose corn syrup, used as a sweetener. Some 20 percent of the 2013 crop was exported to nations such as Japan, Mexico, and Korea. China was another large customer until 2013, when it halted the trade due to genetic modification concerns.

SOYBEANS

The soybean, a legume native to Asia, is prized as a source of both amino acids and edible oil, components of products as diverse as margarine and biodiesel fuel. Once the oil is extracted from the bean, the remaining meal is used as animal feed or processed into flour or tofu. Just as important, soybeans favor the same climate and soil conditions as corn, and replenish nitrogen that corn removes from the soil. Farmers often rotate corn and soybeans in their fields from year to year for that reason, with the split in acreage driven by market demand. Not surprisingly, the Corn Belt states also lead the nation in soybean production, shipping the beans to processing plants around the country, which in turn ship oil and meal to domestic manufacturers and foreign buyers. The U.S. produced a record crop of nearly 4 billion bushels of soybeans in 2014, followed closely by Brazil and Argentina. In most years, about half the cash value of U.S. production is exported, but in 2014 the rising U.S. dollar and ample stocks worldwide held back shipments.

WHEAT

Cultivated in the Middle East since prehistoric times, wheat is the third-largest world crop (after corn and rice, the latter being of minor importance in North America). In the U.S., wheat is grown in several basic varieties. Durum wheat, planted primarily in the northern-tier states of North Dakota, Montana, and Idaho, and in Arizona and California, is processed into semolina flour used for pasta. Hard red spring wheat is also produced mainly in the northern tier and is used for bread. Hard and soft red winter wheat is milled for bread and pastry production, respectively; it's harvested in early summer, and thrives in the plains of Kansas, Oklahoma, and Texas. Soft white wheat, grown largely in the Pacific Northwest, is used for the same purposes.

The U.S. is the third-most-prolific wheat-producing nation, behind China and India. U.S. production declined about 10 percent from 2012 through 2014, when slightly over 2 billion bushels were harvested, as more acreage was switched to corn. Typically, 40 to 60 percent of the U.S. crop is exported. Canada (No. 5 in production behind Russia) is also a significant wheat source, growing primarily red spring and durum varieties. In 2014, Western Canada produced 27.5 million tons of wheat, down 27 percent from the record 2013 crop, due to poor growing conditions. Most Canadian wheat is exported.

OTHER GRAINS

Other important grains produced in North America include oats (used for animal feed and food products) and barley (used for animal feed and, when malted, brewing beer), which grow primarily in the northern-tier states and Canada; sorghum and millet (animal feed), grown primarily on the Great Plains; and rye (animal feed and breads), grown primarily in Oklahoma and Georgia. — *Michael W. Blaszak*

rare in these areas. However, where grain is harvested far from navigable rivers, ports, or domestic customers, railroads have more pricing power. In places where the mergers of the past half-century have left just one railroad, that carrier's power has been magnified — and so, too, has the anger of grain shippers at their plight.

The most prominent example of this can be found on the plains of Montana and western North Dakota. Following the 1970 merger of Great Northern and Northern Pacific, and the withdrawal of the Milwaukee Road during the 1980s, BNSF Railway has become the only practical mode of transporting much of this region's grain to market. Relations between the railroad, its farming customers, and the local politicians those customers elect, have been rocky for years owing to rate issues.

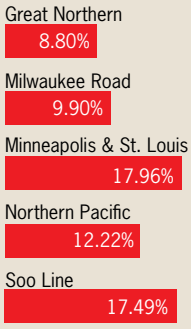
GROWING GRAIN RAIL TRAFFIC

Two men take in a farming exhibit aboard a Northern Pacific train.

Many carriers spent lavishly to educate farmers as to the wisdom of crop rotation and modern agricultural techniques. Rock Island, for its part, coupled with Iowa State College in 1904 to sponsor a four-car "Seed Corn Gospel Train" that toured much of the Hawkeye State. In 1911, Northern Pacific dispatched its "Good Farming Train," which drew large crowds at its Minnesota stations. And in 1928, Southern Pacific put together a 15-car "California Agriculture Special" that made 24 stops in the Golden State for the purpose of advancing marketing opportunities for producers in the San Joaquin and Sacramento valleys. As late as 1952, Northern Pacific joined with Great Northern and Soo Line to send a "Soils Train" to 47 North Dakota stations.

Elsewhere, Missouri Pacific and Rock Island promoted rice-growing in Arkansas by establishing demonstration plots and by introducing new seed stock. Illinois Central and Missouri Pacific were enthusiastic about soybeans, and did much to popularize that crop throughout their respective service territories. — *Don L. Hofsommer*

Grain's importance in the traffic mix varied by carrier, but was vital for railroads in agricultural regions. Here is grain as a percentage of total tons in 1928.



Crowds swarm a Southern Pacific farming special at Riddle, Ore. Two photos, Don L. Hofsommer collection

In 2002, for example, BNSF cut rates to shuttle-train levels for 52-car shipments of wheat originating in eastern North Dakota and western Minnesota, bound for Portland, Ore. This dropped the 52-car rate from those points to an amount lower than the 52-car rate from Montana to Portland, even though Montana origins were up to 800 miles closer to the port. Though BNSF did not comment on its motivation, it's no secret that the railroad competes with CP (connecting with Union Pacific) for grain moves between Minnesota and Portland, while no other railroad offers service from most of Montana to Portland.

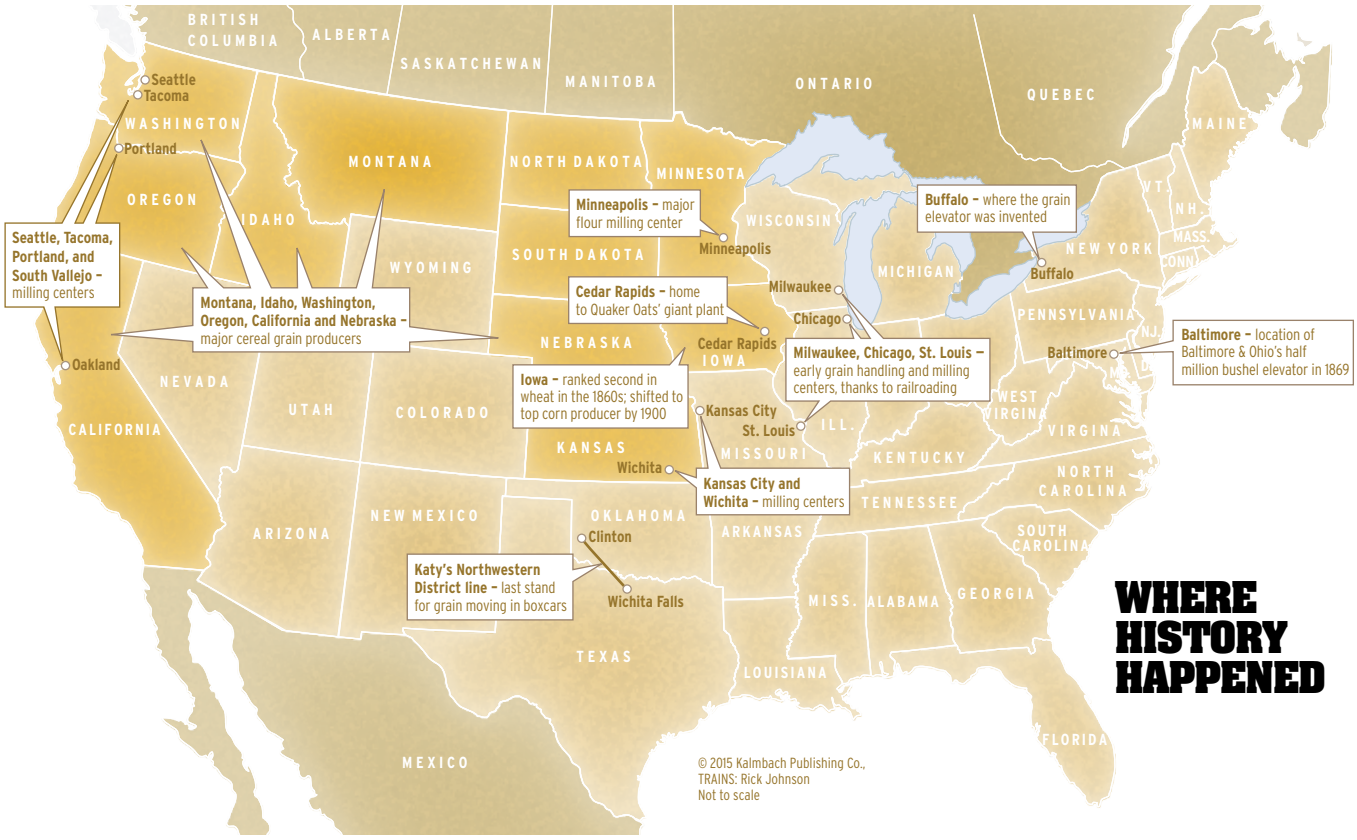
"This tactic really kicks Montana producers when they are already down," remarked Jim Christianson, who was executive vice president of the Montana Wheat & Barley Committee at the time.

BNSF later revised its tariffs to eliminate this discrepancy, but complaints about high rail rates for "captive" grain shippers continued. The controversy was fanned by an October 2006 report prepared by the U.S. Government Accountability Office at the request of members of Congress representing these shippers. The GAO found that rail rates had generally declined following the 1980 enactment of the Staggers Act to the inflection point of 2001, and thereafter had begun to rise. But the trend was not uniform: "From 1985 through 2004," the report found, "coal rates declined 35 percent while grain rates increased 9 percent."

"Potential captivity," in terms of no effective rail-rail competition, is concentrated in North Dakota, Montana, Idaho, and West Texas, among other areas, and substantial regions of the first two states generated sharply higher tonnages of high-rate traffic in 2004, compared with 1985. "The results of our analysis," the GAO concluded, "suggest a reasonable possibility that shippers in selected markets may be paying excessive rates relating to a lack of competition."

Stung by the GAO's implicit criticism of its efforts to protect shippers — and gibes from farm-state legislators that it was, in the words of U.S. Sen. Byron Dorgan, D-N.D., "dead from the neck up" — the Surface Transportation Board held a hearing on rail grain rates in November 2006. After listening to gripes by shipper groups and defensive testimony from BNSF and other railroads, the STB announced on Jan. 14, 2008, that it had hired Christensen Associates, a Madison, Wis., consulting firm, to provide a comprehensive analysis of issues relevant to grain transportation.

Christensen's report, released on Nov. 3, 2008, found that rail "shippers with no or very limited transportation options tend to pay higher rates" than other shippers, and that these higher rates enabled railroads to charge less for other traffic that was subject



WHERE HISTORY HAPPENED

to robust competition, a practice known as "differential pricing." In contrast to the GAO, though, Christensen concluded railroads were raising their rates primarily to cover their increasing costs, not abusing their market power. The 2008 report recommended that the government follow "incremental policies" to widen the competitive options for high-rate shippers like the Montana farmers, such as expanding reciprocal switching and terminal access for railroad competitors. In a 2010 supplement, Christensen found little had changed.

As the STB considered the state of rail-versus-rail competition and shipper proposals to expand reciprocal switching, BNSF took a different approach, entering into a 2009 agreement with two Montana agricultural groups to mediate wheat and barley rate disputes. Through this cooperative relationship, fostered by "listening sessions" at an annual barbecue hosted by the railroad, BNSF agreed to give smaller elevators a six-cent-per-bushel rate break in 2011 by letting them consolidate their 48-car movements into 110-car "Destination Efficiency Trains," which can be loaded in 24 hours and unloaded at multiple destinations. Gordon Stoner, who chaired the farm groups' steering committee, commented that "these [rules] have the flexibility to deliver smaller trains to smaller customers while gaining the efficiencies of 110-car loading."

Another contentious rate issue has been the surcharge railroads imposed to recover the diesel fuel cost, which increased an average of 23.9 percent a year from July 2002 through June 2008. An STB decision in January 2007 found that the practice most railroads followed, assessing surcharges as a percentage of the tariff rate charged, was unreasonable because it bore no direct relationship to the fuel consumed by the movement. UP thereafter shifted to a mileage-based surcharge like the one BNSF adopted voluntarily in 2006; NS elected to roll fuel costs into its published rates.

IN CANADA, DIFFERENT LAWS, SAME PROBLEMS

Across the border, Canadian grain farmers face transportation issues similar to those of the Northern Plains states. There aren't any river outlets from the prairie provinces to the sea; grain has to travel by rail to an ocean port or an urban market in Canada or the U.S., and the cost of rail service is substantial. One shipper claimed in March 2008 that rail rates were the largest single cost borne by prairie farmers, at C$40,000-50,000 per year (all monetary amounts in this section are in Canadian dollars). The difference is that, in Canada, the farmers have a stronger legal position to force rail rates down.

Under the Crow's Nest Pass Agreement of 1897, CP agreed to reduce its grain rates in return for federal aid to construct a new line over that Rocky Mountain pass from Alberta into British Columbia. The reduction turned into a rate freeze in 1925, applicable to Canadian National as well as CP. Political pressure kept these increasingly uneconomic rates in effect until 1984, when the government permitted tariffs to rise gradually to a maximum of 10 percent of the grain's value on the world market, subsidizing the rest of the railroads' costs. In 1995 the rate subsidies were eliminated entirely, and in 1996 the Canada Transportation Act, deregulating railroad transportation, became effective.

Global economics govern when and how grain moves, hence the corn prices on display at Oakes, N.D. Lew Ableidinger

EVOLUTION OF GRAIN TRAVEL

1911
Boxcar with grain door introduced
Charles W. Bohi

1961
Southern Railway debuts Big John
Norfolk Southern

1965
ICC approves lower freight rates; American Car and Foundry debuts 4,600-cubic-foot car Stan Mailer

1968
Cargill and Illinois Central Railroad begin "Rent-a-Train"
Illinois Central Historical Society

A CN crew spots covered hoppers in Dauphin, Manitoba, on July 26, 2006. Mark Perry

While the act permits confidential transportation contracts like those legalized by the Staggers Act in the U.S., it also empowers the Canadian Transportation Agency (Canada's counterpart to the STB) to impose open-access requirements. Any rail-served industry within 30 kilometers (19 miles) of an interchange between two railroads can ship on either one, paying a prescribed switching charge. Railroads also are required to publish "bottleneck" rates to the nearest junction with competing lines.

Not surprisingly, prairie farmers and provincial governments let their members of Parliament know how unhappy they were when the low Crow's Nest rates began to rise. In 2000 the Transportation Act was amended to give farmers some relief. The amendment permitted CN and CP to charge shippers whatever they want, but if annual revenues from grain movements between prairie origins and the port cities of Vancouver and Prince Rupert, B.C.; Thunder Bay, Ont.; and Churchill, Man.; exceed caps established by the act, the offending railroad must contribute the excess plus a 15-percent penalty to the Western Grains Research Foundation. Since the amendment became law, CN and CP have taken great care to stay under their caps, though not always successfully; the railroads exceeded the caps by $60 million in 2008.

Meanwhile, two shortline operators were hatching plans to provide competitive service over CN lines under Section 138 of the Canada Transportation Act. That provision authorized the CTA to order trackage rights on terms the agency considered "just and desirable." One of the applicants was the Hudson Bay Railway, owned by OmniTRAX, which purchased CN's route from The Pas, Man., to Churchill in 1997. HBR sought trackage rights to serve shippers on more than 1,500 miles of CN lines in Manitoba and Saskatchewan in order to boost traffic levels to the port of Churchill. The other applicant was Ferroequus Railway, headed by one-time CP engineer Tom Payne, who had gone on to operate the Central Western Railway, a CN spinoff in Alberta. Ferroequus sought trackage rights over CN from North Battleford, Sask., to

C. 1980

Railroads buy 4,750-cubic-foot covered hoppers to ship whole grains

Cody Grivno

1984

Boxcar grain shipping ends in U.S.

Richard Cecil

1995-96

286,000-pound maximum adopted; Boxcar grain shipping ends in Canada

Cody Grivno

2003

AAR allows 286,000-pound cars to move in open interchange service

Steve Glischinski

TODAY

Covered hoppers have curved sides and no visible reinforcements

Cody Grivno

the Pacific port of Prince Rupert, a distance of 1,350 miles. Both carriers promised substantially lower rates to shippers.

CN opposed both proposals, and was relieved when the CTA rejected them in May 2001. Ferroequus tried again later that year, submitting a new application to run on CN from Lloydminster, Sask., and Camrose, Alta., to Prince Rupert, gathering business from CN shippers as well as CP customers through the interchange at Camrose. The agency held a hearing on the proposal in Winnipeg in April 2002, at which a CN representative protested, "What you've got here is an attempt by somebody who doesn't have the network, who didn't build it, who doesn't maintain it, and who wants to use it in a way that we don't think is practical." That argument won the day. On Sept. 10, 2002, the transportation agency denied the second Ferroequus application on the grounds that imposition of trackage rights is an exceptional remedy," which it would not order without evidence that CN was abusing its market power.

Shippers continued to complain about grain rates to the ports, coupled with grumbling about slow service and an inadequate supply of cars. In February 2008, the CTA responded by reducing the CN and CP grain traffic revenue caps by a total of $72.2 million, or 8 percent, retroactive to August 2007. The rationale for this reduction was that CN and CP were being overcompensated for covered hopper maintenance by about that amount. Angrily responding that Canadian grain rates already were "significantly less" than comparable rates in the U.S., then-CN Chairman Hunter Harrison called the decision "an unfair ruling" that would "permanently damage CN's grain business." Canadian farm groups fired back with a consultant's study claiming that, even after the cap reduction, CN and CP were earning about $100 million in "unreasonably excessive costs," reflecting the way they were run in 1990, not today.

CN appealed the cap reduction in court, but the Federal Court of Appeal decided to let the agency's ruling stand in a November 2008 decision. The railroad protested that the lower cap would cost it $23 million in revenue, turning what had been a remunerative business into its least profitable commodity group. Harrison said that, as a result, "CN will have to carefully review its future investments in grain-related equipment and infrastructure." Nonetheless, CN continued budgeting capital funds to improve its lines through the prairies.

UP and CP team up to move Upper Midwest grain to Pacific Northwest terminals via the Columbia River Gorge. A westbound rolls through Meno, Ore. Tom Kline

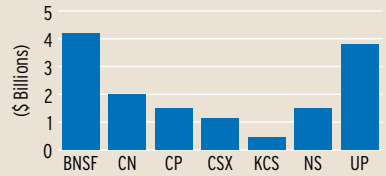
The Canada Transportation Act was amended in February 2008 to lower the standard for imposing relief such as trackage rights, no longer requiring a finding that a shipper would suffer "substantial commercial harm." To date, no new open access proposals have surfaced, though the change in the act amounts to an open invitation for them. The amendments also authorize final offer ("baseball") arbitration to resolve rate disputes. In 2013, Parliament passed the Fair Rail Freight Service Act over the objections of CN and CP. This legislation gave shippers the right to request a service contract from a railroad, with the CTA arbitrating any disputes. If the railroad breaches an arbitrated agreement, it faces fines of up to $100,000.

During the 1970s and 1980s, the federal government purchased 13,000 covered hoppers to ease a car shortage and to replace obsolete 40-foot boxcars in this trade, while Alberta, Saskatchewan, and the Canadian Wheat Board bought thousands more with public funds. Under the Crow's Nest rates, the railroads had no financial incentive to make that investment. CN and CP use these cars for free to move regulated grain; they must pay for using them to haul other commodities. In 2005, the federal government agreed to sell the surviving 12,100 cars to Farmer Rail Car Coalition in an effort to balance "the interests of producers with those of the industry and taxpayers." However, after failing to reach an agreement with the farmers, government officials decided a year later to keep the cars in order to "maximize benefits for farmers and taxpayers." In 2007, the government established new 10-year agreements with CN and CP for use of the federal car fleet, agreeing to pay for repairs and replacements for cars retired owing to derailments or mechanical condition.

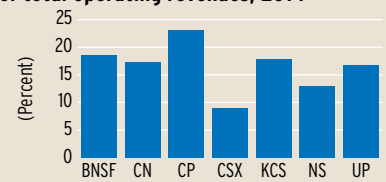
Continuing its efforts to drive grain shipments into trainload quantities, CN in 2006 reserved most of the cars for advance booking in blocks of 100 for 42 consecutive weeks. The Canadian Wheat Board and five

GRAIN TRAFFIC BY THE NUMBERS

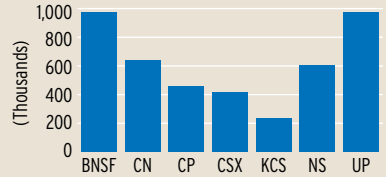
Class I agricultural group revenues, 2014



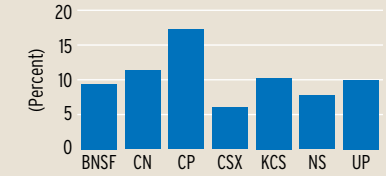
Agricultural group revenue as a percentage of total operating revenues, 2014



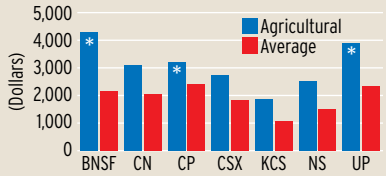
Agricultural group revenue carloads moved, 2014



Agricultural group revenue carloads as a percentage of total traffic, 2014



Agricultural group revenue per car versus average revenue per car, 2014



*Denotes highest revenue per car among all of that railroad's commodity groups.

Note: All CN and CP monetary amounts in Canadian dollars.

Source: Class I 2014 annual reports and 10-K filings. Variations in reporting among railroads occur as follows. BNSF: Agricultural group includes corn, wheat, soybeans, fertilizer, ethanol, and bulk foods. CN: Grain and fertilizers group includes food grain, feed grain, oilseed and oilseed products, and fertilizers. CP: Grain group includes wheat, corn, rye, oats, barley, plus processed products such as canola meal, vegetable oil, and flour; does not include fertilizer. CSX: Agriculture products group includes feed ingredients, soybeans, and ethanol. KCS: U.S. figures only; excludes KCS de Mexico. Agriculture and minerals group includes grain, food products, ores, and minerals. NS: Grain, fertilizer, and ethanol fall under the agriculture, consumer products, and government group. UP: Agricultural group includes grain products, whole grains, and food and refrigerated products.

A BNSF grain train heads west at Lyle, Wash., on Oct. 24, 2012. Steve Schmollinger

other shippers complained that this practice violated CN's service obligations under the Transportation Act. In a January 2008 decision, the CTA agreed that CN had failed to supply sufficient cars to meet the needs of smaller shippers. CN already had revised its reservation practices, but the agency ordered the railroad and the complaining shippers to file data concerning CN's performance during the 2007-08 crop year to make sure. After implementing a car-scheduling operation in 2010, CN modified its ordering policy again in 2014 to require naming origins and destinations in an effort to cut down duplicate requisitions.

CONGESTION AND CHAOS

Despite massive investments in shuttle-loading facilities, larger cars, and more locomotives, grain transportation by rail stumbled in 2014, due to several factors. The 2013 corn harvest rebounded strongly from the drought-shriveled 2012 crop, and it came in quickly, just as the western railroads, principally BNSF and CP, were experiencing a surge in unit oil train and fracking-sand shipments. Indeed, BNSF claimed that half the railroad industry's increased traffic in 2013 moved over its system, and half of that moved to or from North Dakota. Capital investments to add capacity required maintenance windows that further constricted grain-shuttle operations.

Then came one of the most severe winters in history, with heavy snows and cold temperatures prevailing from January 2014 onward. Bitterly cold weather forces railroads to shorten train consists in order to maintain brake-pipe pressure, which reduces equipment productivity and requires more train crews to move the same volume of business, along with more delay-inducing meets at sidings. The mostly single-track CP admitted a 30-percent decline in average train speed in early 2014. Snow and frigid conditions also cause equipment, track, and switch failures to soar and congeal yards. Demand for electric power increases when it's cold, too, generating more utility coal shipments when the railroads are least able to move them.

To grain shippers, the consequences were disastrous. Shuttle-train cycles from Montana to the Pacific Northwest ballooned from 10 to 22 days or more, when the trains ran at all. Elevators reported that they would load a shuttle train in the allotted time, then watch the crew uncouple the locomotives and disappear over the horizon, letting the train sit for a week or more before power returned to move it. Deliveries of non-shuttle equipment fared far worse, with BNSF spotting some empty cars with COTS commitments for late January 2014 in early July. In an era when U.S. grain is sold around the world and shipments have to make sailing dates in port, these delays and unreliability were intolerable. So was the cost. Since equipment is ordered through COTS which can be traded among elevators, the shortage of cars resulting from poor utilization pushed the price of the right to load one car from the typical $100-200 to as much as $6,000 on the secondary market, according to shippers, plus $4,000 or more in tariff charges to move the car. COTS for empty cars in September and October 2014 remained above $2,700, and rates edged up as the year progressed. BNSF further angered smaller elevators when it required shippers of 48 to 55 cars to call competitors and match their shipments up with similar movements to the same destination, or pay the much higher single-car rate. Elevators resorted to trucking grain to their feedlot customers, since otherwise the animals would die, and dumping the rest of the crop on the ground, where it deteriorated, because their storage bins were overflowing.

The STB convened hearings on "U.S. Rail Service Issues" in Washington during April 2014 and in North Dakota in September 2014. After accepting copious written and oral testimony, the Board ordered BNSF and CP to file weekly status reports on their grain and fertilizer movements in April, and extended reporting require-

ments to the other Class I railroads in October. But it hasn't taken further action, other than proposing to make the reporting obligation permanent.

In recent months, the railroads concentrated on whittling down their backlog of grain traffic while investing record amounts — $6 billion for BNSF alone in 2015 — in their infrastructure to catch up to demand and restore velocity to acceptable levels. On top of more second main track and sidings, railroads are buying new-design covered hoppers that are shorter than previous models. A 116-car train of the new cars fits in the same siding as a 110-car shuttle of older cars, but holds 5 percent more cargo. BNSF bought 900 of these new cars in 2014 and expects to take delivery of the same quantity in 2015 and 2016.

Congestion was just as severe in Canada, where a huge 2013 harvest and the cold winter weather overwhelmed the railways' ability to move the grain to ports and continental markets. Responding to loud complaints from agricultural interests, the Conservative government headed by Prime Minister Stephen Harper ordered CN and CP to double their grain-carrying performance to 500,000 metric tons a week by April 7, 2014. Parliament followed up with the Fair Rail for Grain Farmers Act, which became effective on May 29. This legislation and its implementing regulations mandated minimum weekly grain movement volumes for the two transcontinentals, increased the open-access limits in the prairie provinces from 30 to 160 kilometers (18.6 to 99.4 miles) to encourage competition, and imposed reporting requirements. The railways struggled to meet the minimums, and CN was fined for a shortfall in September 2014. By February 2015, though, CN reported it was moving 21 percent more grain than it had a year earlier, helped by its Commercial Fleet Integration Program meant to lure private covered hoppers into Canadian grain service, while CP was bypassing Chicago congestion by routing grain trains to Buffalo, N.Y. Satisfied that the railroads had made substantial progress, the government quietly allowed the minimum volume mandate to expire on March 28, 2015.

Tensions between railroads and shippers have been a legacy of grain transportation since homesteaders first settled the North American prairie, and no doubt they will continue even after the current congestion fades into history. Railroads will continue to maximize their profits from this volatile business, just as the drive for efficiency will continue to change how grain transportation looks and behaves. But when the next bowl of cereal is poured, and another steaming plate of pasta arrives at the family table, chances remain good that the railroads helped make it happen. T

THE PROMISE OF ETHANOL

A BNSF freight, with run-through Norfolk Southern C40-9 No. 8815, heads east with mostly ethanol cars, at Shabbona, Ill., on Jan. 1, 2013. Rick Burn

Being in the right place at the right time sums up the railroads' circumstances with respect to the phenomenal, albeit government-driven, growth of the renewable fuels industry. Ethanol, the most common biofuel additive to gasoline, is made by fermenting corn in large quantities. The railroads already had branch lines in place throughout the corn belt to gather this crop. The end product is mixed with gasoline near points of consumption, often distant from the Midwest, and it cannot be practically shipped via existing pipelines. What remains of the corn after fermentation, known as dried distillers grains, can be used as animal feed.

All of these products are transported by rail, although in recent years corn has increasingly moved from farm to distillery by truck. Dan Sabin, president of the Iowa Northern Railway, estimated that "a 100 million-gallon plant means 3,500 carloads of ethanol, 3,500 carloads of distillers grains, and 2,000 carloads of corn annually" — all typically new business. No wonder the rail industry remains enthusiastic about ethanol's potential, even as it moves more crude oil.

Using ethanol as a motor-vehicle fuel isn't new; Henry Ford designed his first car to run on it. After World War II, though, leaded gasoline became so cheap that it pushed costlier ethanol out of the market. Ethanol made a return during the first energy crisis of the 1970s to stretch gasoline supplies and as an alternative to lead for boosting octane, since lead has harmful health effects. Lead was banned from gasoline in 1986, by which time gasoline sold in the Midwest typically contained up to 10-percent ethanol. Congress aided ethanol's growth with subsidies (phased out in 2011), favorable financing, and tax incentives.

Two changes are responsible for the current ethanol boom. Methyl tertiary butyl ether, a gasoline additive used to control carbon monoxide emissions in smog-prone areas, was detected in drinking water sources and deemed a health threat. States began outlawing the additive in 1999; California's 2004 ban was an epochal event. Ethanol was the only practical substitute.

In response to geopolitical concerns about dependence on oil produced by hostile nations, Congress passed the Energy Policy Act of 2005 and the Energy Independence and Security Act of 2007, both mandating prodigious increases in ethanol fuel consumption. Under the latter statute, 36 billion gallons of ethanol a year must be blended into fuels by 2022. By 2013, producers were churning out 13.3 billion gallons.

For railroads, ethanol traffic proved a bright growth story. As ethanol use increased outside the Midwest, resulting in longer hauls, rail market share grew to 60 percent by 2005. Like other volume movements, the industry attempts to maximize productivity by running as many long-distance solid and unit trains as possible. BNSF ran its first solid train of agricultural products, including ethanol, malt, feed, and corn syrup, from Willmar, Minn., to Barstow, Calif., without intermediate switching in April 2003. In October of that year, BNSF launched its Ethanol Express, a 95-car unit tank car train running from various Midwestern origins to the refining center of Carson, Calif. Ethanol Express expanded to Fort Worth, Texas, in 2006. CSX began unit train service, which it also calls Ethanol Express, to Albany, N.Y., in March 2004. Investments continue in terminals to unload unit ethanol trains on the coasts. Even short lines remote from the Midwest, such as Providence & Worcester, got in on the game. By 2011 railroads were carrying some 350,000 carloads of ethanol a year.

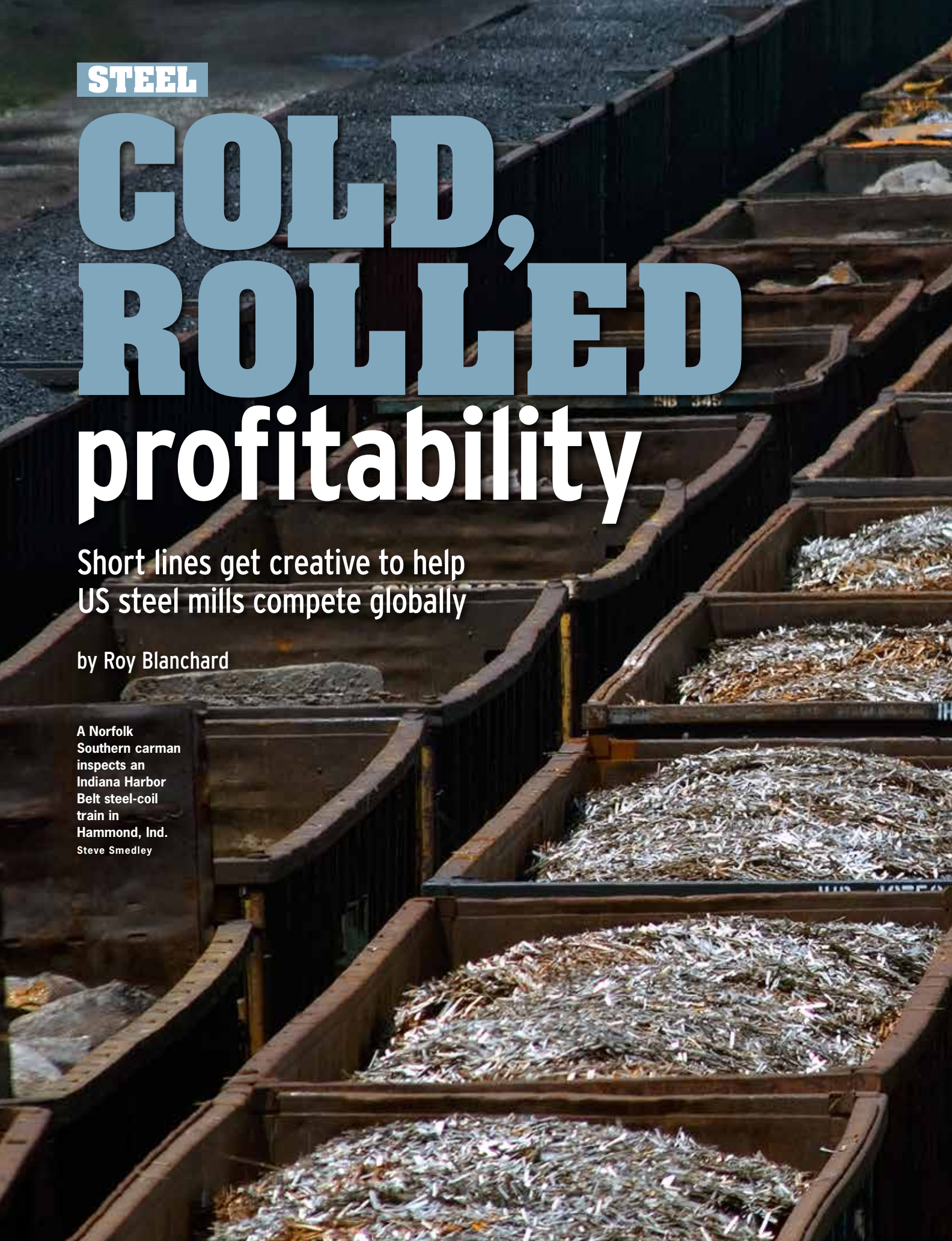
Despite plunging oil prices in 2008 and 2014, the federal ethanol legislation remains in force, protected by farm-state legislators bent on promoting agribusiness. Even some hard-right, pro-market Republican presidential contenders are quiet on the issue, fearful that coming out against ethanol will hurt them in the 2016 Iowa caucuses, where some 73,000 jobs depend on the fuel. China's ban on genetically modified corn is keeping distillers grains out of that market, depressing rail shipments, but trainloads of ethanol are still rolling from the Heartland to the coasts, and probably will keep on moving until the federal legislation is modified or repealed. — *MWB*

STEEL

COLD, ROLLED profitability

Short lines get creative to help US steel mills compete globally

by Roy Blanchard



A Norfolk Southern carman inspects an Indiana Harbor Belt steel-coil train in Hammond, Ind.
Steve Smedley


4018
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When moist air made Nucor's rolled steel rusty, Finger Lakes Railway stepped up to protect loads and turn them faster using modified gondolas. Finger Lakes' B23-7 No. 2309 leads a gondola train west to Geneva, N.Y., after switching cars near Syracuse, N.Y. TRAINS: Mike Yuhas

Standing trackside and watching carloads of steel go by in its various forms — coils, bars, rods, scrap, iron ore — is one thing. It's something else to know where it came from, where it is all going, and why. The "why" is the most interesting part of the move, after all, and it is here that shortline and regional railroads are doing the most creative and innovative work.

Non-Class I railroad examples illustrate how railroads can translate customers' transportation requirements into carloads because so much of this work is local, and local presence helps. The Class I railroads themselves acknowledge that reliable first-mile and last-mile performance are essential in any rail business. This being the short lines' specialty, it's easy to understand why short lines touch one of every five cars you'll see in any mixed freight on any Class I railroad.

Putting it together, the story of steel loads on steel rails is one of close cooperation between manufacturer and transportation supplier. The former has the flexibility to load cars to fit scheduled transit times so as to minimize delays en route. For the latter, knowing which cars are to be loaded on which days makes car supply more fluid and predictable. And the end users, the metal fabricators that make everything from I-bars to I-beams, benefit from less inventory in transit, less inventory on the floor, and fewer work stoppages from raw material delays. A million-plus cars of steel riding the rails gives eloquent testimony to a true supply-chain partnership.

CENTRAL NEW YORK WONDER

In Western New York's Finger Lakes Region, the eponymous Finger Lakes Railway has created interesting train moves involving the creative use of cars, Class I railroad relationships, and an understanding of customer-specific supply-chain requirements. Finger Lakes worked with the Nucor Corp. plant at Auburn, N.Y., to find a way to send rolled steel shapes, or merchant bar, to its Vulcraft division at Chemung, N.Y., 80 truck miles and 107 rail miles away on Norfolk Southern's Southern Tier Line, just west of Waverly, N.Y.

The 60-foot-long Nucor-made angled pieces and strips had been sent to Chemung on flatbed trucks with tarp covers. Unfortunately, water condensed on the bars, causing rust spots. Road salt got under the tarps in winter months causing yet more quality defects. Surely, there had to be a better way. Jan McNeal, Finger Lakes' marketing vice president, says that Norfolk Southern supplied 13 65-foot mill gondolas, for which Finger Lakes designed and built special covers that would keep the steel dry.

Because these are purpose-built cars, the railroads had to turn the cars promptly and the customer had to commit to sufficient volumes for the cars to justify their initial cost as well as their continued upkeep. McNeal says Nucor and Vulcraft gave the railroads a three-year volume commitment on tonnage. The Auburn plant rearranged its rolling schedule to maximize car turns and minimize dead in-plant storage time.

The upshot is that cars are getting more than two turns a month. Nucor is moving substantial volumes in this lane and is looking to expand the program later in 2015, railroad officials say. This means that Finger Lakes can plan to add two more cars to this dedicated fleet for this move and possibly others because, as use goes

Steel slabs are loaded onto gondolas for further processing. U.S. foundries rarely use only raw materials. Roy Blanchard

Providence & Worcester B39-8 No. 3902 and B40-8 No. 4001 take each end of train CT-1, pulling onto "Kellys Lead" at CSX Transportation's Cedar Hill Yard in North Haven, Conn. This train is heading north with loads for a Middletown, Conn., steel company. Thomas Mik

up (and turn times go down), you can redeploy cars to gain new market share in other routes.

A second Nucor success story concerns raw steel ingots used as feedstock for products such as rebar, rod, and shaped steel. The receiver is a sister facility that uses the Gateway Terminal transload facility in New Haven, Conn., a Providence & Worcester Railroad customer.

Again, equipment is key. P&W was able to supplement the Finger Lakes' gondola fleet with additional 52-foot cars. Thanks to a fleet-sizing project, the two short lines collaborated with CSX Transportation on volumes and rates that are competitive to expand the business further in 2015. Both the Chemung and New Haven moves are examples of steel loads seen on Class I manifest freights that originate or terminate on short lines.

Between Auburn and other raw steel suppliers in the U.S. and Canada, P&W does nearly 200 cars a month of ingots for its metal fabricator suppliers — more gondolas on the Class I railroad manifest carload networks. There are another 50 to 60 cars a month of steel slab, coils, and structural shapes. All this metal-bending is going to generate scrap that can be used in electric-arc furnaces to create yet more ingots. Frank Rogers, P&W's vice president and chief commercial officer, says scrap can run another 100 cars a month between export and domestic traffic.

MISSISSIPPI STRONG

Elsewhere in North America, the Genesee & Wyoming shortline holding company has doubled its steel-hauling presence in North America over the past few years.

Columbus & Greenville Railway GP38 No. 2777 sits on a track in Mississippi with steel-coil gondolas. Track improvements were key to securing steel moves. Hamhari Brown

From a Mississippi plant of Steel Dynamics Inc. to Essar Steel Algoma in Ontario and Cascade Steel in Oregon, G&W railroads support 17 different steelmakers and fabricators, and interchange carloads with each of the North American Class I railroads.

Winning new business means investing in one's own railroad first. Take Steel Dynamics, for instance. The company had completed a $550 million capital program to double the capacity of its Columbus, Miss., facility and outfit it with a second, state-of-the-art electric-arc furnace. The strategic objective was to grow its business in new markets as the leading low-cost producer of high-quality steel. And it needed a strong railroad to do it.

"G&W stepped up to the plate with a $1.5 million upgrade on our Columbus & Greenville Railway that serves [Steel Dynamics]. Our capex program included extending tracks, improving bridges, adding remote-control yard power, and installing yard lighting to accommodate working at night in order to handle increased traffic," says Michael Miller, G&W's chief commercial officer for North America. "Additionally, we reconfigured the south end of our

FROM RUSSIA TO SHARON (with love?)

Most of the steel tonnage today is scrap in, steel shapes and coils out. It wasn't always so. The history of Sharon, Pa.'s Sharon Steel Corp., now NLMK Pennsylvania, paints a vivid picture of how the steel industry has changed and how that evolution has affected the railroads that served them.

Seventy years ago, Sharon Steel was turning out 482,000 gross tons of steel annually. The recipe for just the iron to produce that tonnage is awesome: 960,000 tons of ore, 195,000 tons of limestone, 420,000 tons of coke for the molten iron. All of it came from somewhere else — ore from Minnesota by lake boats and rail, limestone and coke from Pennsylvania suppliers, also by rail. The 100,000 tons of scrap steel, more or less, depending on end uses, came roughly 50-50 from in-plant processes and external vendors.

Over the years, competition from off-shore suppliers and lower-cost electric-arc furnace mini-mills caused the traditional iron-ore-to-steel coke-fueled operations to lose market share. Sharon Steel was no different. The last blast furnace shut down in 1992 and bankruptcy followed. Assets went through a series of ownerships and failures until becoming part of NLMK Pennsylvania about four years ago.

The manufacture of slab, rolled, and galvanized products continues with one big difference: no more blast furnaces. The company imports some 19,000 gondola loads of raw steel slab through the Port of Philadelphia from the NLMK Group, the largest steelmaker in Russia. Conrail Shared Assets serves the port directly and builds unit trains of 75 to 100 cars each, which Norfolk Southern forwards to the complex at Sharon.

Even so, NLMK Pennsylvania annually dispatches about 1,000 railroad carloads of finished coiled steel — one-tenth of total output — to customers in New England, the Southeast, and Midwest. The carloads of inbound ore and limestone, and the intra-plant slab transfers, may be gone, but the old Sharon Steel plant lives on through innovation and the ability to change with the times. — *Roy Blanchard*

Coiled steel makes its way westbound over Union Pacific's Mojave Subdivision at Keene, Calif. Steel coils and bars were the main steel loads in the U.S. in 2014. William Steck

TOSS-UP for Class I steel king

Which Class I railroad comes out on top with steel moves? Depends on where you look. Norfolk Southern has the strongest franchise in the finished and intermediate products groups, thanks in large measure to its Pennsylvania Railroad heritage. CSX Transportation and NS swap first place in scrap from quarter to quarter each year, with CSX ahead by 10 percent as of February 2015. Canadian National hauls more iron ore than anybody, with 150,000 carloads a year. BNSF Railway comes in second at 40,000 cars. The fact that ArcelorMittal produces about 2 out of 5 tons of Canadian iron ore helps CN make a claim for steel king.

Overall, data show carloads of iron and steel products at the end of 2014 running at more than 10,000 a week. That's the highest level since November 2007 for what's been an eight-month parade of consecutive highs. Iron and steel scrap carloads, however, drifted below the 4,000 mark for the first time in three years, continuing a persistent up-and-down pattern. Iron ore loadings were relatively soft but finished 2014 at the highs of four years ago.

According to government information, most of the steel on the railroads is in the form of coils and strips or slabs, with scrap second, and iron ore in third place. This is an important note as scrap and ore are used as raw material for everything else. — *Roy Blanchard*

East Yard, installing a crossover to increase throughput and lower per-unit costs as well as improving the interchange connection between Columbus & Greenville and BNSF Railway."

The relationship seems to work well for both the Columbus & Greenville and Steel Dynamics. Sources say the latter has a focus on high-margin customers in the automotive and oil industries, and will expand production to 3.4 million tons a year. The G&W short line will handle much of it. The location couldn't be better: Mississippi is well-positioned for supporting Southeast automakers such as Mercedes, BMW, and Volkswagen, and the oil- and gas-producing regions in the near Southwest.

Elsewhere, G&W serves electric-arc furnaces in northern Ohio with a steady stream of scrap steel.

"G&W railroads reach more than 125 different scrap customers, ranging in size from large companies such as [David J. Joseph Co.] to smaller, local scrap dealers, and even steel mills themselves," says Marty Pohlod, G&W's Ohio Central Railroad commercial vice president. "Annual volumes from this scrap customer base easily exceed 20,000 carloads."

And though pig iron ranks low on the Class I commodity totem pole, it's important to G&W's integrated steel customers for its high carbon content. And again, much of it uses a Class I railroad connection for some part of the move.

THE CHICAGO WAY

In the Chicago area, ArcelorMittal's Burns Harbor steel mill relies on the Chicago South Shore & South Bend, one of the Anacostia Rail Holdings properties, for providing the right railroad equipment at the right place and time.

"The degree of supply-chain coopera-

One traditional view of steel mill railroading is a lift bridge over the Cuyahoga River framing Cleveland Works Railway Co. SW1500 No. 1551 as it works light on industrial tracks that are inside and surround ArcelorMittal's steel complex in Cleveland. TRAINS: Steve Sweeney

tion between ArcelorMittal and us perpetuates a true working partnership with the South Shore. [Burns Harbor] is by far our largest single carload customer," says Anacostia Rail Holdings Chief Commercial Officer Eric Jakubowski. "I don't say this lightly — we accomplished this over years of hand-holding and trying to be responsive."

South Shore expanded its metals business to the point that it represents a sizable percentage of the 55,000-car-per-year franchise. The South Shore's mission is made even more challenging by three things. First, it uses a mostly single-track main line shared with the Northern Indiana Commuter Transportation District commuter service. Second, given the many short-haul moves, area truckers are aggressive in pricing. And third, the number of intermediate classification yards (one or more for each of six Class I railroads) that touch South Shore's line can lead to bunching of trains, playing havoc with just-in-time delivery requirements.

Burns Harbor puts about 10,000 cars a year of outbound steel coils and plate on the South Shore, split 60-40 between the southern Midwest automobile plants and the railcar builders — TrinityRail, Freight-Car America, Greenbrier Cos., American Railcar Industries — scattered around the country. There are also several hundred boxcars a year out of the independent precoat facility in near-by Kingsbury, Ind.

Practically next door to Arcelor is U.S. Steel's former National Steel facility, acquired in 2003, where the South Shore has recovered traffic after a lengthy price war over the plant's typically short-haul business. Jakubowski says that this capacity for supplying cars as needed and turning them quickly is a significant competitive advantage for railroad and steelmaker alike.

Feeding the Arcelor furnaces takes coal and scrap steel. The coal comes from the Northern Appalachia region and western Canada in as many as 200 unit trains a year that the South Shore forwards, power and all, to Arcelor. Scrap comes on Lake Michigan barges and is handed off to the South Shore for delivery to Arcelor. And a recent change in Arcelor shredder operators has created new avenues of rail-delivered scrap. T

Blast furnaces and exhaust flares are becoming rare as traditional foundries are replaced with mini-mills. TRAINS: Steve Sweeney

A Norfolk Southern steel-coil train heads south at Elsmere, Ky. NS, CSX, and CN are steel-hauling champs. Brian Schmidt

An eastbound BNSF container train climbs Crawford Hill in northwestern Nebraska on Oct. 2, 2003. Howard Ande

INTERMODAL

The future of railroading RIDES ON A HIGHWAY

Challenges and opportunities abound when it comes to intermodal transportation

by Michael W. Blaszak

If you bought it from Walmart. If you bought it from Target. If you bought it from Best Buy or Home Depot or Canadian Tire, and it was made in China or Thailand or Indonesia, it probably came to North America in a container. And there's an increasing likelihood that at least part of its journey to your store was by rail.

What about that package from Amazon that came in the mail, or the book you bought on eBay that arrived via UPS? Or the new car in your garage? There's a good chance the packages on your doorstep and the parts in your vehicle also traveled in a trailer or container on a train.

Intermodal transportation — the movement of trailers and containers — is a substantial component of North American railroad traffic. In fact, intermodal passed coal in 2013 as the industry's biggest revenue producer among major traffic categories. In 2014, the U.S.-based Class I railroads tacked another 665,630 intermodal loads onto their 2013 totals, notching a record 13.5 million shipments. Intermodal is likely to become even more significant in coming years, as the industry invests heavily to divert more and more over-the-road truck movements to rail.

INTERMODAL VS. TRUCKS

Nonetheless, railroad intermodal movements still represent a relatively small share of North American commerce. That 13.5 million figure sounds like a lot, but the tons of freight loaded into trucks, and the revenue earned by long-distance motor carriers competing directly with the railroads, tower over comparable figures for the entire railroad industry.

Whether a trailer or container goes by rail for part of its journey depends on customer demand and cost factors honed down to a knife's edge. Transferring equipment between highway and rail takes time and costs money. For a transcontinental haul, terminal costs are a relatively small part of the equation, often allowing the efficiencies of hauling 300 containers on ribbons of steel behind a two-person crew to tip the scales. Railroads enjoy about 40 percent of this market. But most freight movements are much shorter than Chicago to the West Coast, and here trucks have a natural advantage. The gray area between long and short hauls — 550 to 750 miles — along with long-distance movements of perishable and high-value goods are where the competition between road and rail is most fierce.

After peaking in 2006, U.S. intermodal loads sank during the Great Recession, as demand for consumer goods lagged and hungry truckers undercut rail rates. But the truckers could not keep that up for long. Their costs kept growing due to several trends, most importantly the price of fuel, which increased markedly after a 2008 crash. Intermodal transportation is nearly four times more fuel-efficient than trucking, according to the Association of American Railroads. When the cost of diesel rises, the motor carriers are disadvantaged, and the fuel efficiency of rail service attracts shippers who want to "go green."

How tomorrow moves ... at 25 mph. Service consistency, not pure speed, is often the key to success in intermodal. Brian Schmidt

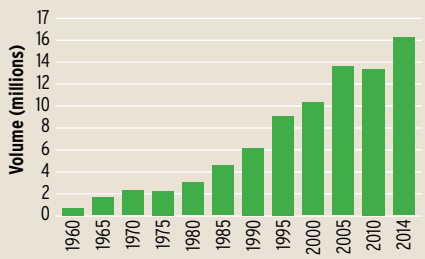
Other factors contributed to intermodal's resurgence in the first half of the current decade. A multi-year regulatory battle over truck drivers' hours of service within the U.S. culminated in new and tighter rules imposed by the Federal Motor Carrier Safety Administration on July 1, 2013. Drivers now are limited to driving 11 hours during a 14-hour shift, then must take 10 hours off. Carriers such as Schneider International say the new rules clipped driver productivity by 3 to 4 percent, raising their costs. And the rest requirements have led to a new problem: where to park

A seemingly endless line of J.B. Hunt containers heads east along Norfolk Southern's former Conrail Chicago Line at Vermillion, Ohio, on July 4, 2014. George Hamlin

the big rigs, which are unwelcome in most places, while the drivers sleep.

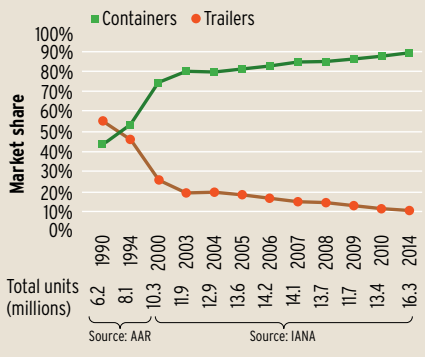
Maintaining the 4-million-mile U.S. highway network the truckers use is proving increasingly challenging. The Highway Trust Fund, fed by federal fuel taxes, supports road repair. Due to increasing costs and stagnant revenue — the tax rate hasn't increased since 1993, and there is little congressional will to hike it — the Trust Fund hasn't been able to meet its obligations since 2007, forcing Congress to supplement it with general revenues. Though the condition of the nation's highways improved during the last half of the 2000s, according to the Department of Transportation, they'll inevitably deteriorate under the daily pounding of traffic unless the federal government comes up with more money for maintenance. Given the legislative gridlock in Washington, this is far from a sure thing.

TOTAL INTERMODAL VOLUMES



Source: Intermodal Association of North America

TRAILERS VS. CONTAINERS



Source: Intermodal Association of North America

Then there's the human resources issue. It's difficult to find trustworthy drivers with commercial licenses who are willing to accept the nomadic existence and uncertain pay of the long-distance truck driver. Motor carriers complain that their driver populations are aging, and that younger adults have little interest in piloting 18-wheelers over the road, sacrificing time with friends and family. It's not uncommon for drivers to quit and work for building contractors when construction picks up. The pay is better and they don't end up sleeping in a truck stop 500 miles from home.

All these factors favor moving trailers and containers by rail. But intermodal has its challenges, too. Railroad service quality deteriorated in 2013 and 2014 due to severe winter weather and heavy rail traffic, in particular the surge of unit oil trains and fracking-sand shipments. By one estimate, intermodal train speed dropped about 6 percent from 2013 to 2014, making service slower, less reliable, and less efficient. Despite rapidly escalating capital budgets, the railroads still haven't been able to get ahead of their rising tide of traffic.

When fuel prices swooned during the second half of 2014, frustrated intermodal shippers reacted to lower truck rates by pulling loads over the road when they could. But this is likely to prove a temporary phenomenon. The obstacles facing long-distance trucking are too great to reverse the long-term trend favoring intermodal.

TRUCKERS TRANSFORMING

Recognizing the trend, many motor carriers have repositioned themselves as regional networks feeding intermodal trains, following the lead of United Parcel Service, which has been shipping by rail extensively for more than four decades.

J.B. Hunt exemplifies this paradigm. Starting with its namesake founder's famous handshake with then-Santa Fe President Mike Haverty in 1989, Hunt has progressively shifted resources from over-the-road trucking to arranging intermodal shipments and providing logistics services. In 2014, Hunt's Intermodal division carried 1.7 million loads in its 73,000 trailers and containers, which sport a green "Intermodal" logo. Hunt's over-the-road division is shrinking as the company evolves into a supply-chain manager for its major industrial and retail customers. Hunt continues to work primarily with BNSF Railway in the West and, in 2009, entered into a multi-year contract with Norfolk Southern to move shipments in the East.

Privately held Schneider National doesn't release as much information as Hunt, but it is also increasing its intermodal footprint. In 2009, Schneider phased out its last intermodal trailers, and instead has more than 16,850 orange containers in intermodal service. Claiming intermodal is "striking the sweet spot between truck-like reliability and low-cost service," Schneider promotes "unlimited" equipment access and "priority placement" on the trains of its rail partners, BNSF in the West and CSX Transportation in the East.

In 2006, Schneider commissioned its own train, the Buckeye Connection, between the Marion (Ohio) Industrial Center and Kansas City, Mo., over CSX and Kansas City Southern, to connect the underserved industrial heartland with California, Mexico, and Pacific Rim markets. Since then, Schneider's relationship with CSX has continued to tighten, with the trucker advertising "you can ship to traditionally high-cost, hard-to-serve markets like Florida and the Northeast" by rail for up to a third less than over-the-road. Schneider also runs a dedicated chassis fleet and a bulk intermodal trailer service for moving chemicals; it saw 75 percent growth in the first six months of 2014.

The third-largest truckload carrier, Werner Enterprises, told stockholders in 2009 that "over the last three years, we dramatically reduced our medium-to-long-haul van fleet to limit our exposure to a market with intense competition from small carriers and intermodal providers." Since then, Werner has limited its over-the-road tractor fleet to about 7,300 units and expanded intermodal and other services. Werner president Derek Leathers told an industry gathering in 2013 that "the intermodal conversion is here to stay. If we put our head in the sand and attempt to ignore it or defend freight that could go intermodal and keep it on a truck, that story probably doesn't end well." Averitt Express announced in April 2010 that, after digesting survey results from 20,000 customers, it would begin handing off truckload shipments to the four major U.S. railroads and Florida East Coast. Swift Transportation, which has been partnering with railroads since the early 1990s, offers shippers a fleet of 56,000 53-foot intermodal containers, which it began sending to Mexico in 2011. Truckers like C.R. England are pairing with BNSF to move frozen

Kansas City Southern intermodal train IVNKC, a Schneider National train, is seen at Granite City, Ill., in July 2010. Marshall W. Beecher

foods and hardy perishables like carrots and onions eastward by rail in "cold chain" refrigerated containers. Even flatbed operators who rarely used rail in the past, such as Alabama-based Boyd Bros., have added intermodal to their portfolio of services.

For years FedEx Freight was the holdout, proclaiming no interest in supplementing its over-the-road service with rail. But in January 2011, it followed the trend, announcing a new "economy" intermodal alternative under arrangements with the four largest U.S. railroads and Canadian National. FedEx Freight now offers both trailer and container equipment to its customers.

INTERNATIONAL TRAFFIC SHIFTING

With the migration of manufacturing to lower-cost platforms in Asia and elsewhere, ocean carriers became the railroads' primary source of intermodal business, disgorging millions of containers onto stack trains. Backhauls of exported manufactures, agricultural products, and recycled materials grew as well. The number of 20-foot-equivalent units (TEUs) moving through U.S. ports was 78.1 million in 2012, an increase of more than 50 percent from 2002.

For decades, the most efficient route from Asia to major U.S. markets in the Midwest, South, and East — most of the population still lives east of the Mississippi River — has been through West Coast ports, primarily Los Angeles and Long Beach, Calif. Historically, these two ports account for a third of all container commerce, as the constant stream of intermodal trains on BNSF and Union Pacific attests.

But Southern California's maritime dominance is dimming. The ports experience congestion at peak times. They are expensive — average annual pay for longshoremen exceeds $142,000 — and they impose costly mandates to clean up truck exhaust and employ drayage drivers directly. The railroads, leveraging their strong market position, have increased rates in recent years, and Los Angeles is still 2,200 miles or more from Chicago, a lot farther than the Atlantic is. Due to these disadvantages and the recession, traffic through the Los Angeles and Long Beach ports increased just 0.7 percent between 2004 and 2012.

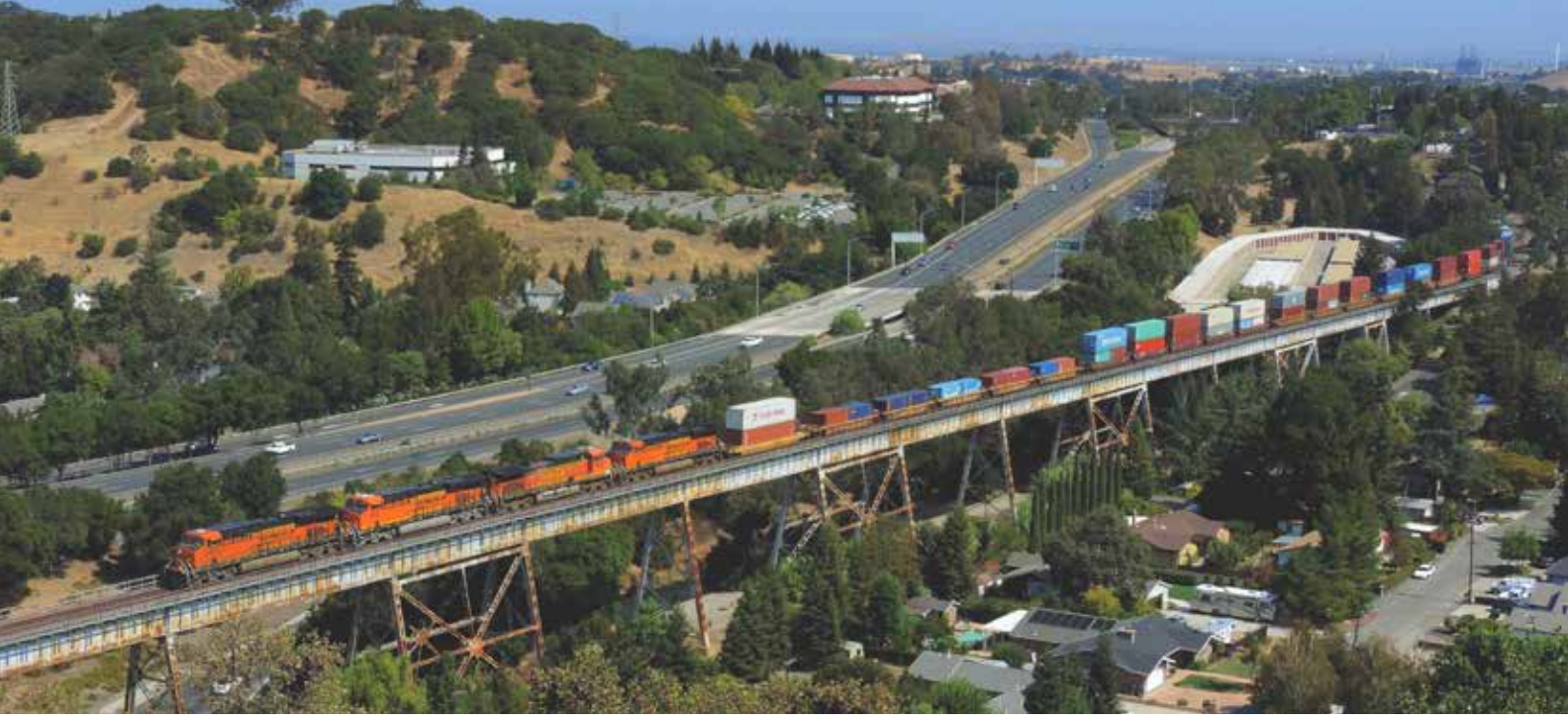
The labor contract between the International Longshore and Warehouse Union, representing West Coast port workers, and the Pacific Maritime Association, representing 29 ports, expired on June 30, 2014. Months of negotiations failed to produce a new agreement. Meanwhile, high volumes at the ports resulted in congestion and delays that only got worse when the dockworkers union began work slowdowns in October 2014 and briefly suspended loading and unloading operations in February 2015. After a tentative agreement was reached later in February, throughput at the ports boomed 33 percent over year-earlier figures in March as workers cleared the backlog of containers.

INTERMODAL PASSED COAL IN 2013 AS THE INDUSTRY'S BIGGEST REVENUE PRODUCER AMONG MAJOR TRAFFIC CATEGORIES.

The Panama Canal, completed in 1914, can accommodate container ships carrying up to 5,000 TEUs. Ships have long since grown larger than that, adversely affecting the canal's competitiveness. In 2005, Panamanian voters approved a $5.3 billion expansion of the 50-mile waterway to accommodate vessels carrying 13,000 container units. This project, to be completed in 2016, will make all-water transits from Asia to East Coast and Gulf of Mexico ports more economical. Even today, Asia-North America shippers wanting to avoid West Coast costs and congestion can ship through the Suez Canal or transload U.S.-bound freight from Asia-Europe sailings, which have lower rates, to smaller ships in the Mediterranean. In 2014, Egypt's government announced plans to build a New Suez Canal, expanding the existing canal to allow ships to move in both directions simultaneously and doubling its capacity.

Major importers such as Walmart and Home Depot began diverting shipments through the Panama Canal during the 2000s, building warehouses in southern Texas that were supplied by containers unloaded at Houston. Atlantic ports boomed as the shift gathered steam, with container movements through Savannah, Ga., rising more than 10 percent in 2014 to 3.34 million container units as ocean carriers took advantage of its proximity to Atlanta. The ports and the shipping lines predict that once the canal is enlarged, container flows to the East Coast will accelerate.

Meanwhile, Kansas City Southern has been developing its intermodal franchise between the Midwest and Mexico since ob-



A BNSF container train, westbound for Oakland, Calif., crosses the John Muir Viaduct in Martinez, Calif., on Aug. 7, 2013. Ryan Clark

taining full control of what's now known as KCS de Mexico in 2005. KCS invested $275 million on reopening the former Southern Pacific Macaroni Line between Rosenberg and Victoria, Texas, slicing 67 miles off its route between Houston and the Mexican border, and opening or expanding terminals at Rosenberg and five points within Mexico. The effort has paid off, with intermodal revenues reaching $357 million in 2013, a 16 percent year-over-year increase, and with happy customers like Schneider National touting the new north-south marketing opportunities they have. But KCS believes it's carrying just 1 percent of the 2.6 million truck movements across the border, and the potential for further growth is almost unlimited. KCS isn't alone: UP commenced expedited service between Memphis and the Mexican border at Laredo, Texas, in January 2014, and BNSF and Ferromex followed in May with a new train from Silao, Mexico, to compete for this business.

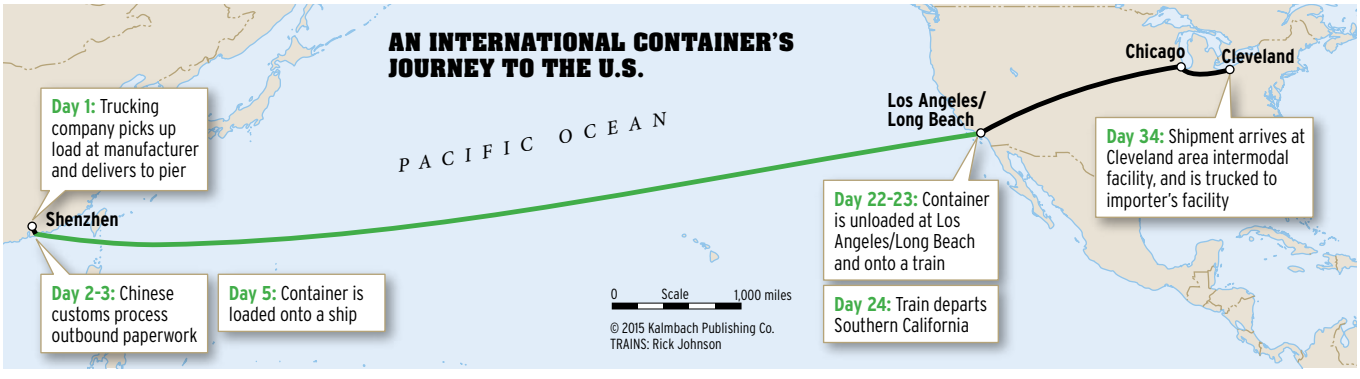
The southern terminal of what KCS calls its International Intermodal Corridor is the port of Lázaro Cárdenas, 535 rail miles from Mexico City in the state of Michoacán. Lázaro Cárdenas is Mexico's busiest seaport, and KCS's entry ignited a meteoric rise in container throughput from 132,479 container units in 2005 to 1.2 million in 2012. Unfortunately, all this activity attracted Mexico's drug gangs, which imported raw materials for methamphetamine through the port. The Mexican military took over the facility in November 2013, and worried shippers diverted their movements through other ports in 2014 until the military stabilized the situation. Nonetheless, APM Terminals obtained a 32-year concession in 2012 to develop a second deepwater terminal at Lázaro Cárdenas which, when it opens in 2016, will increase the port's capacity to 3.8 million container units a year.

IN THE WEST, EFFICIENCY RULES

A.P. Moller-Maersk, the world's largest ocean carrier, turned heads in February 2011 when it announced orders for 20 new container ships with the astounding capacity of 18,270 container units — nearly 30 percent bigger than anything riding the waves before. Maersk's new "Triple E" liners, 15 of which are in service at this writing, ply the Asia-Europe shipping lane, since most North American ports can't berth them. China Ocean Shipping Co. will soon top the Triple Es with five new ships that can carry 18,400 container units. These huge new ships exemplify carriers' relentless drive for economies of scale. Maersk estimated when its order was announced that the new ships would haul a container for 26 percent less than its largest current vessels.

Much the same is happening on the Western railroads as they drive down unit costs to compete for intermodal traffic. Except for domestic premium shipments, the lowest price wins the business, as long as service is reliable. Preparing for more intense competition from East Coast ports for international shipments, the Western railroads are operating longer and heavier stack trains.

BNSF, whose Consumer Products traffic segment (including intermodal and automotive) produced 31 percent of corporate revenue in 2014, has largely completed the program started by predecessor Santa Fe to add a second main track to the single-track segments of its Chicago-Los Angeles main line. The second track through the most difficult topography on that route, New



Mexico's Abo Canyon, opened in June 2011, permitting operation of up to 130 trains a day. Only four single-track segments remain on the "Transcon," and a 9.3-mile extension west of Vaughn, N.M., will eliminate one of them in 2015. In May 2007, BNSF began running 10,000-foot intermodal trains using distributed power between Los Angeles, Chicago, and Clovis, N.M., where trains swap blocks for different destinations. After successfully operating 800 of these extended-length trains, BNSF stretched the limit to 12,000 feet in 2009. By the end of that year, DPU-equipped stack trains were running from the Pacific Northwest to Chicago as well.

Southern Pacific started to add second track to its 760-mile Sunset Route between Los Angeles and El Paso, Texas, before it was acquired by UP in 1996, and UP (which relies on intermodal for 20 percent of its revenue) has continued the gargantuan project since then, finishing about 620 miles by the end of 2014. East of El Paso, UP is extending sidings and constructing stretches of new second track on both the Sunset and the former Texas & Pacific routes. UP also raised clearances on the former SP transcontinental main line over Donner Pass to divert Northern California stack trains off its former Western Pacific route, which is longer and slower. The rebuilt Donner Pass route, completed in 2009, is under centralized traffic control and can handle 9,000-foot trains; siding length limits trains on the ex-WP to 5,700 feet.

Canadian Pacific completed its $160 million Western Capacity Expansion Program in 2006, adding and lengthening sidings on its transcontinental main line. "Westcap" increased CP's capacity over the Rocky Mountain summit to 38 trains a day, while introduction of DPU operations and implementation of advanced software allowed the railroad to begin operating stack trains of up to 12,000 feet between Vancouver and Toronto in 2009. Westcap was followed by a Network Capacity, or "Netcap," program in 2011-2012, which extended nine sidings in North Dakota and Minnesota, and CP said in late 2014 that it would continue to invest in added capacity through 2018. Intermodal makes up 21 percent of CP's business, and container traffic through Vancouver has more than doubled in the past decade, zooming past Seattle. CN adopted a similar strategy, spending $400 million in the 2000s to extend existing 6,000-foot sidings to 10,000-12,000 feet and build new ones. Half of CN's intermodal trains now employ distributed power, and CN expects to lengthen them to 12,000 feet.

Still-longer trains are feasible. On Jan. 8, 2010, UP train IDILBF-08 quietly slipped out of the railroad's Dallas Intermodal Terminal on its way to Long Beach. Nothing was extraordinary about this stack train except its size: 295 cars, 618 containers, 15,498 tons, 18,061 feet in length. It was the longest train UP had ever operated. The 3.5-mile consist, powered by nine locomotives (three on the point, two on the rear, and two pairs mid-train) made it to California without mechanical problems, achieving speeds of up to 65 mph. Trains of this size won't be common until the Sunset Route second track is completed, but it's clear UP's drive for efficiency won't stop at 12,000 feet.

Even with all this investment, the Western railroads are struggling to carry their intermodal load. BNSF's service between Chicago and the Pacific Northwest, in particular, has suffered from congestion caused by increasing oil and grain train volume and capital projects to add capacity, to the point that intermodal schedules ballooned from 72 to 135 hours. In May 2014, UP inaugurated an expedited Chicago-Portland, Ore., train to compete for BNSF's priority business on this route. Constraints on locomotive production as the builders adapt to the new Tier 4 emission standards may also weigh down the railroads' intermodal growth in 2015 and 2016, since they will find it more difficult to expand capacity by simply buying more units.

INTERMODAL TRANSPORTATION IS NEARLY FOUR TIMES MORE FUEL-EFFICIENT THAN TRUCKING.

IN THE EAST, PREPARING FOR GROWTH

Intermodal traffic traditionally was less important to the two large Eastern railroads. CSX and NS were coal roads, relying more on carload service to industrial customers. Analysts used to think an intermodal load had to go 800 to 1,000 miles by rail to be profitable, which essentially ruled out anything but end-to-end movements on these properties.

But the traditional industrial market in the East continues to decline, and with truck costs rising and more international shipments moving through East Coast ports, the Eastern carriers see intermodal as their big growth opportunity. It's now thought that railroads can make money on intermodal movements as short as 550 miles, making more Eastern city-pairs profitable lanes as productivity improves.

With intermodal traffic migrating to double-stack containers in the 1980s, the older rail networks of the East faced the expense of improving their tight clearances to handle the new equipment. Economics supported the work on a limited number of high-density routes, such as Conrail's trackage between Chicago and northern New Jersey. Others, particularly main lines with

TTX: EQUIPMENT PROVIDER

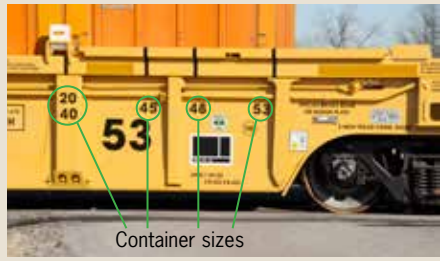
Railroads recognized early on that trailer-on-flatcar "piggyback" traffic was unlike any other that they carried. Because of this, they set up the Trailer Train Co., now known as TTX Co., in 1955 to pool such equipment. The equipment pool made it easier to establish industrywide standards, like the retractable flatcar trailer hitch, which led to the phenomenal growth seen in the intermodal segment.

Today it is jointly owned by nine North American railroads: BNSF, Canadian National, Canadian Pacific, CSX, Ferromex, Kansas City Southern, Norfolk Southern, Pan Am, and Union Pacific.

TTX provides a variety of intermodal equipment, including traditional flatcars, multi-purpose spine cars, and well cars. Its most common well cars are five-unit, 40-foot sets for carrying 20-foot, 40-foot, and 45-foot international containers; and three-unit, 53-foot articulated railcars for transporting domestic containers. They carry DTTX reporting marks. The company's standard intermodal fleet consists mostly of five-unit, 53-foot, articulated spine cars, which can accommodate 28-foot to 53-foot trailers. They carry TTAX reporting marks. TTX also rosters 89-foot, solid-deck intermodal flatcars, many with RTTX reporting marks.

The U.S. Surface Transportation Board has authority under federal law to approve pooling arrangements such as this. The TTX pool was most recently approved in October 2014 for a 15-year term.

TTX also provides flatcars for general service, automotive loading, and oversize loads, as well as a pool of modern boxcars and gondolas. In 2012, the company had more than 143,000 cars available in interchange service. — *Brian Schmidt*



TTX's modern intermodal equipment can accommodate a variety of container sizes, as shown here. Brian Schmidt

CSX intermodal train Q034 proceeds north across Powell's Creek, north of Quantico, Va., on Sept. 11, 2012, on former Richmond, Fredericksburg & Potomac trackage. The train's route is not yet fully cleared for double-stacked containers. George Hamlin

NS train No. 233 cosses the magnificent Coopers Trestle, near Bramwell, W.Va. Completion of the Heartland Corridor project allows double-stacks on the former Norfolk & Western main line. Samuel Philips

numerous tunnels, remained closed to double-stack trains until the railroads, unable to make the investment case on their own, sought capital infusions from the public.

Conrail teamed with the state of Pennsylvania to fund its $80 million project to bore out tunnels and improve other clearances between Philadelphia and Pittsburgh on its former Reading and Pennsylvania Railroad lines in 1994-95. Later, Massachusetts helped Conrail remove restrictions on its Boston Line. Following their 1999 acquisition of Conrail, NS and CSX have continued to seek public assistance to finance double-stack clearance projects.

A decade of political and engineering effort culminated in the Sept. 9, 2010, opening of NS's Heartland Corridor, the $191 million revamping of the former Norfolk & Western main line through the Appalachians to clear double-stack trains. The 38-month construction project, which enlarged 28 tunnels and raised 24 overpasses, was financed primarily by grants from the federal government and investment by NS, with Virginia and Ohio contributing smaller amounts. Until the Heartland Corridor was completed, NS had to move double-stacked containers to or from the Port of Virginia at Norfolk via either Harrisburg, Pa., or Knoxville, Tenn., adding as much as 331 miles and two days' transit time to the route to Chicago. Construction of the new Rickenbacker Intermodal Terminal at Columbus, Ohio, was included in $130 million of associated improvements. Just two or three double-stack trains a day in each direction ply the Heartland Corridor now, but NS expects volume to grow, stating in June 2010 that it would use federal stimulus funds to extend the route from Columbus to Cincinnati by removing five overhead obstructions.

Bigger still is NS's Crescent Corridor, a $2.5 billion multi-year plan to improve clearances and build terminals along 2,500 miles of main line from New Jersey to New Orleans and Memphis. Pitching the program as "the most comprehensive public-private partnership for improving freight transportation in the East," NS expects to divert up to 1.3 million truckloads from overloaded highways onto a network of 28 "dedicated Crescent trains" by the time the corridor is built out in 2020. The Crescent Corridor involves four major new terminals, at Rossville (Memphis), Tenn., McCalla (Birmingham), Ala. (opened 2012), Greencastle, Pa., and Charlotte, N.C. (opened 2013). NS partner Florida East Coast expanded its service between NS's new Charlotte terminal and South Florida points in 2014. These two massive projects helped NS grow its intermodal business to the second-highest volume in the industry, behind BNSF.

THE NUMBER OF 20-FOOT-EQUIVALENT UNITS MOVING THROUGH NORTH AMERICAN PORTS WAS 78.1 MILLION IN 2012, 50 PERCENT GREATER THAN 2012.

CSX dubbed its counterpart project the National Gateway, involving 61 clearance expansion projects on the former Baltimore & Ohio between the Atlantic seaboard and northwest Ohio; the former Chesapeake & Ohio to Columbus; and the former Richmond, Fredericksburg & Potomac and Atlantic Coast Line between Washington and North Carolina. Phase 1 of the National Gateway, permitting double-stack operations over the former B&O between new terminals in Chambersburg, Pa., and North Baltimore, Ohio, was finished in September 2013. CSX is now working on Phase 2, which will clear the trackage between Chambersburg and the mid-Atlantic ports of Baltimore; Hampton Roads, Va.; and Wilmington, N.C. States and the federal government have committed $280 million to the project's $842 million price tag, and CSX expects to invest about $395 million. Opened in 2011, North Baltimore has been successful in diverting traffic that previously flowed through congested Chicago terminals, and a $42 million capacity expansion was announced in 2014. Another CSX project, the Liberty Corridor Freightway, used state and federal funds to bore out two tunnels in Jersey City, N.J., allowing double-stacks to reach New Jersey ports.

GROWTH THROUGH COOPERATION

One way to lengthen short Eastern intermodal hauls is to expand the network, a strategy Norfolk Southern embraced by extending to Dallas and New England through joint ventures. In 1995, NS teamed up with KCS, which had bought MidSouth Corp. two years previously, to provide the first intermodal service between Atlanta and Dallas via the onetime MidSouth connection at Meridian, Miss. The railroads restructured the route for growth in May 2006 by setting up Meridian Speedway LLC, with KCS contributing the 320-mile line from Meridian to Shreveport, La., and NS putting in $300 million in cash for a 30-percent ownership stake. The new company is investing

NS's funds in capital improvements such as 250 miles of new centralized traffic control signaling, 100 track-miles of used rail, and siding extensions.

No longer a 25-mph Illinois Central backwater, the Meridian Speedway gained transcontinental intermodal trains in 2007 when NS and UP shifted their Atlanta-Los Angeles "Blue Streak" service from Memphis to Meridian, shortening the route by about 150 miles. In 2009 a deal with Florida East Coast extended NS's transcontinental reach to a new terminal in Titusville, Fla., serving Orlando and Tampa.

NS repeated the formula in a May 2009 deal creating Pan Am Southern LLC. It uses Pan Am Railways' 155-mile, former Boston & Maine route from Mechanicsville, N.Y., to Ayer, Mass. With $137.5 million in NS cash and property, the new company upgraded the track of this 50-50 joint venture for 40-mph operations, and invested in new intermodal terminals in Mechanicsville and Ayer, which serves the Boston area. NS redoubled its commitment to the New England market in late 2014, when it agreed to acquire 282 miles of CP's Delaware & Hudson between Sunbury, Pa., and Binghamton and Schenectady, N.Y., for $217 million, sealing its control over Pan Am Southern's connection to the west. The deal is subject to Surface Transportation Board approval, expected in 2015.

In addition to the Buckeye Connection to Kansas City, CSX cooperates with FEC in reaching ports and terminals in Fort Lauderdale and Miami, and Iowa Interstate to serve Council Bluffs.

Florida East Coast, pictured northbound at St. Augustine, Fla., is banking on increased intermodal traffic to finance its colorful new ES44C4 fleet. TRAINS: Brian Schmidt

EQUIPMENT, RATES, AND TERMINALS

New containers, like those bearing the CSX logo on page 31, conform to the domestic standard: 53 feet long, 102 inches wide, and 110 inches tall. These dimensions (which may vary by a few inches) intentionally replicate the standard size and carrying capacity of an over-the-road trailer, so that shippers don't have to modify their loading patterns to use intermodal. Fleet owners have mostly phased out the 48-foot domestic boxes that were common in past decades.

International containers mostly conform to the International Organization for Standardization cross-section of 96 inches wide and 102 inches tall, primarily in lengths of 20, 40, 45, and 48 feet. In 2007 APL introduced 53-foot-long, 102-inch-wide containers in trans-Pacific service, but these nonstandard boxes are limited to APL ships. Many import-carrying ISO containers are transloaded to 53-foot domestic equipment after reaching North America for delivery to inland distribution centers.

The intermodal trailer has become practically an afterthought. As it cannot be double-stacked, it's less efficient to handle than a container, and generally railroads are interested in moving trailers only in domestic premium service at relatively high rates. The railroads stopped providing trailers to customers in 2005, and now most trailers riding flatcars are supplied by the rails' trucking partners, who are also switching to containers. A surprising uptick in trailer volumes occurred in 2014, but analysts theorized it represented the temporary flow of spare highway equipment into the intermodal system as traffic slowed down due to bad weather and congestion.

Once thought to be a viable solution for converting medium-haul truck movements to intermodal, RoadRailer's growth

INSIDE THE BOX

Illustration by Roen Kelly

What's inside the box? On double-stack trains, it's just about anything. Inside the containers are consumer goods from China for big-box retailers and imported components for U.S. manufacturers. You'll find toys, sporting goods, and microwaves for Sears; patio furniture, bicycles, and artificial Christmas trees bound for Target; and the Japanese ship engines and drive trains to build Toyotas in Kentucky.

American resources fill boxes returning to Asia. They contain waste paper, scrap metal, soybeans, and animal feed. When there is nothing to ship, the boxes go back empty.

The Port of Los Angeles, the nation's largest container port, says furniture is the biggest intermodal import, followed by auto parts, apparel, electronics, and footwear. The biggest intermodal exports are waste paper, animal feed, scrap metal, fabrics and raw cotton, and auto parts.

East Coast ports handle many of the same goods, but have their specialties as well. Bottled water, juice, and Red Bull energy drink cross the docks at The Port of Virginia and move inland on trains. Containers of logs arrive by train for export. "We export a lot of American hardwoods, including oak, cherry, and walnut, to China, and it comes back as American hardwood furniture," says Joe Harris, spokesman for The Port of Virginia.

Double-stack pioneer APL ships everything from frozen shrimp to electronics, auto parts, and apparel on the trains.

Stack trains play a key role at nationwide retailer Crate & Barrel. Containers of Asian ready-to-assemble tables, chairs, and bookcases land at West Coast ports. Placemats, tablecloths, and rugs made in Europe or India arrive at container docks in New Jersey. The company uses stack trains to distribute the merchandise among its distribution centers in California, Illinois, and New Jersey, says Steve Pater, Crate & Barrel's director of transportation.

At Crate & Barrel's Cranbury, N.J., warehouse last summer, a container packed with finished furniture from Asia waited to be unloaded after its cross-country train trip from Tracy, Calif. Another container was loaded with imported glassware, ceramic dinnerware, pillows, and other household goods, all headed by train to the retailer's Naperville, Ill., warehouse.

Chicago is the biggest stack-train hub. Consumer goods stream into the area bound for Walmart, Home Depot, and other big box retailers.

Once emptied, the containers are filled with Midwestern animal feed and grain, sent by train to the ports of Los Angeles and Long Beach, then loaded on ships to Asia. There, the grain is sold to feedlots and food producers.

William DeLong, vice president of grain operations for feed and grain dealer DeLong Co., says the company fills each 40-foot container about 70 percent to the ceiling with grain. DeLong follows railroads' blocking and bracing rules, which include six to eight boards and a cardboard bulkhead assembled in the back of the container to keep the grain from spilling out the back doors.

Imported consumer items are usually packed in brown cardboard boxes. Jill Ellsworth, international logistics coordinator at Murphy Warehouse Co. in Minneapolis, received a 20-foot Evergreen container stuffed floor to ceiling with 2,568 boxes of paint brushes from China.

Some products are heavy and aren't stacked high. Ellsworth says she has seen a container come in with just one 4-by-4-foot crate. She also recalled container loads of honey in steel drums sent from China, Vietnam, and Malaysia. And there were container loads of marble slabs from Italy and Brazil bound for counter manufacturers in the U.S. The slabs were lying on their sides like dominoes lined up in the container, black, gray, and rust-color, she says.

Murphy also handles shipments of Chinese leather coats hanging from ropes strung inside containers. The containers are shipped through Los Angeles or Long Beach, loaded onto stack trains, and sent to a leather wholesaler in the Twin Cities. The container looks "like a big closet," Ellsworth says.

Tom Finkbiner, CEO of Tiger Cool Express LLC of Overland Park, Kan., an intermodal refrigerated produce hauler, isn't surprised by what's in the boxes. "It's furniture, appliances, electronics, clothing, footwear, all kinds of soft goods, towels and sheets, and pots and pans," he says. Containers also carry toys, sauces, bottled foods, canned vegetables, storage containers, razor blades, and golf balls. "Stack trains have become a critical component of department store supply chains," Finkbiner says.

— Dan Machalaba, a frequent TRAINS *author from Vermont*

has been stalled by the Eastern railroads' push to expand double-stack service. Triple Crown Services, an NS subsidiary, remains the primary RoadRailer operator, serving 10 terminals on NS along with Toronto via CP, Dallas-Fort Worth via BNSF, and the Twin Cities via UP, but neither the TCS network nor the 6,468-unit fleet has grown in recent years. Likewise, CP's operation of Iron Highway — later renamed Expressway — drive-on, drive-off trainsets for short hauls is limited to Montreal-Toronto; Detroit service was dropped in 2004. Double-stacked containers in well cars provided by TTX Co. (see page 35) and other owners likely will be the equipment standard for the foreseeable future.

Aside from what's disclosed in regulatory filings, intermodal's economics are opaque to the outside observer. The service was deregulated in 1981, and rates are

An eastbound UP container train pulls out of a sag east of Creston, Ill., near the railroad's Global III intermodal yard in Rochelle, Ill., in April 2013. The railroad developed the rural intermodal yard to relieve congestion in its other Chicago-area yards. TRAINS: Brian Schmidt

privately negotiated among any combination of railroads, ocean carriers, truckers and third parties known as logistics providers and intermodal marketing companies that aggregate individual shipments to obtain lower rates. Hub Group, an intermodal marketing company, said in its 2010 annual report that "transportation rates are market-driven," with railroad price lists serving as the starting point for negotiations. Discounts known as "special commodity quotations" are negotiated for specified shippers and routes and might be valid for up to a year. Movements may be "wholesale," or terminal-to-terminal by rail, or "retail," from truck dock to truck dock with the service provider arranging for drayage and equipment.

Pacer International, originally the domestic service arm of American President Lines, had a long-term contract with UP, locking in low container rates through October 2011. Wanting to recapture control over its pricing, UP held out for substantial changes in the renewal negotiations. In return for a $30 million cash payment, Pacer ultimately agreed to increase UP's compensation to "market" levels over two years, beginning in November 2009, to reduce charges for its double-stack cars to TTX levels, and to turn most of its 53-foot containers over to the railroad. As a result, Pacer ceded to UP control of its wholesale intermodal business, which brought in $391 million in revenue during 2008.

For intermodal traffic to keep growing, terminal capacity has to keep up. The railroads are aggressively investing in expanding existing terminals and building new ones. Union Pacific opened its Global 4 facility near Joliet, Ill., in August 2010, and by 2013 this terminal had become UP's busiest, with 484,000 lifts during the year. UP completed construction of the 250,000-lift terminal at Santa Teresa, N.M., near El Paso, Texas, in May 2014, which will capture truck traffic flowing north through the new Santa Teresa border crossing.

BNSF's new 600,000-lift Memphis facility opened in 2010, and construction of the 1.5 million-lift Logistics Park Kansas City at Edgerton, Kan., wrapped up in 2013. Bigger still is the Southern California Intermodal Gateway, BNSF's answer to the Intermodal Container Transfer Facility completed for SP in the 1980s. Located about 4 miles north of the ports of Los Angeles and Long Beach, the $500 million gateway is projected to handle 570,800 container units when it opens in 2016, rising to 2.8 million when fully built out. BNSF touts the facility as the greenest intermodal terminal ever developed, with electric-powered cranes, low-emission locomotives, and trucks built after 2009 that meet current air-quality goals for the region, primarily powered by natural gas. The gateway, like intermodal transfer, will further improve air quality and reduce congestion by eliminating millions of miles of container drayage between the ports and BNSF's Hobart Yard, some 20 miles to the north.

ON JAN. 8, 2010, UNION PACIFIC OPERATED TRAIN IDILBF-08 BETWEEN DALLAS AND LONG BEACH WITH 618 CONTAINERS. THE 295-CAR TRAIN WEIGHED 15,498 TONS AND STRETCHED 18,061 FEET.

In addition to the new and expanded terminals included in the National Gateway Project, CSX relocated its Beacon Park terminal serving Boston to an expanded site in Worcester, Mass., and opened new terminals in Winter Haven, Fla., and Montreal. CN invested $150 million to expand capacity at its Harvey, Ill., terminal, installed a new facility at Conrich, Alberta, to serve the Calgary market, and is buying 95 acres to expand the Memphis terminal it shares with CSX.

Worried about being left behind in this new intermodal age, smaller urban areas are teaming up with state governments and other funding sources to build their own terminals. Archer Daniels Midland opened a terminal at its Decatur, Ill., processing complex in 2013. The project, assisted by a grant from the Illinois Department of Commerce and Economic Opportunity, permits ADM to export containerized agricultural shipments via NS, CSX, and CN without an expensive truck move to Chicago. A new terminal at the Port of Panama City, Fla., is one of four projects supported by Florida's Intermodal Logistics Center Infrastructure Support Program, which allocates $5 million a year in 50-percent-matching grants to build intermodal capacity within the state, while the Port of Jacksonville is developing its own terminal. But the survival of these smaller facilities depends on their ability to attract enough business to interest railroads bent on keeping their intermodal networks trim. BNSF closed its Fresno, Calif., intermodal terminal in December 2014 due to "a minimal amount of traffic."

A BRIGHT FUTURE

Trucks probably will continue to dominate North American freight transportation in coming years. Most freight moves relatively short distances or requires expedited service that intermodal and other rail alternatives can't match. But heavy investment by the railroads and government entities in intermodal-related improvements demonstrates that container movements by rail are likely to resume their long-term growth as the economy expands, and to bring profits to the carriers' bottom lines. In 2021 or 2031, when you pick up electronics or clothing or hardware from the store, the chance that a railroad brought it will be even greater than it is today. T

The Aventine Renewable Energy plant in Pekin, Ill., served by the Tazewell & Peoria and Illinois & Midland, produces ethanol and related by-products. Steve Smedley

CHEMICALS

Better railroading through CHEMISTRY

As the crude boom abates, high-margin manifest traffic regains its luster

By Gregory DL Morris

The bonanza of inexpensive and plentiful shale oil and gas that helped spur a boom in domestic production has also sparked a renaissance in the chemical industry. And as the downturn in oil prices slows crude oil transport by rail, lower-volume, higher-margin commodities like chemicals are returning to the fore — especially for railroads that specialize in manifest freight.

"The chemical industry is very diverse and serves all other industries," says John Kraemer, group vice president of chemicals for Norfolk Southern. "Chemicals are consumed in metals, paper, oil and gas, and in other segments of the chemical industry. That means a manifest business."

With the exception of ethanol and polymers, chemicals have not been a commodity that offers opportunities for unit-train handling. But that is starting to change.

"Working with shippers, we have been able to form blocks of traffic by destination to reduce handling and improve transit," says James Cairns, vice president of petroleum and chemicals for Canadian National Railway. "Unit trains may become more prevalent [in chemical traffic] as we see a shift to export markets. There are very few, if any, domestic North American destinations that receive unit-train quantities today. As we see new export lanes develop, unit trains may play a role moving the large quantities required to fill out a vessel."

A lone Kansas City Southern unit provides the power for a 10-car Norfolk Southern ammonia extra, easing downgrade through Shawsville, Va., on a rainy March 16, 2013, evening. Samuel Phillips

In absolute numbers, western railroads handle the most chemical carloads. In the years after deregulation under the Staggers Act, railroads competed aggressively for business in the Gulf Coast complexes in Louisiana and Texas. Railroad consolidation also meant concentration, so when Union Pacific merged with Southern Pacific in 1996, it was required to allow BNSF Railway greater access as a designated competitor.

Since then, high prices for energy and feedstock, or raw material, gradually shifted some chemical production off shore. Then came the domestic oil boom, which — coupled with global geopolitics — led to an oil surplus driving prices down by more than half from their summer 2014 highs.

Plenty of crude-oil unit trains still stream out of the shale plays around the country, but growth has slowed in that high-volume business, helping return focus to commodities such as chemicals.

"With the boom in crude by rail, all those unit trains crowded out some manifest shipments," says Don Alexander, senior vice president and leader of the rail and chemicals group at the Savage Companies, a major operator of liquid bulk terminal facilities. "As the domestic crude business stabilizes, some of the railroads are going back after the manifest freight that was run off."

Canadian National is well positioned for chemical traffic, with a network connecting key production centers in Western Canada, notably Alberta, to the U.S. Gulf Coast and Eastern Canada. "Our unique three-coast reach allows us to create end-to-end supply chains that support movements of chemicals throughout North America as well as connect production with tidewater on all three coasts," Cairns says.

He expects seaboard access to become increasingly important: "Relatively inexpensive feedstocks have positioned North America as a low-cost producer for many different intermediate chemicals."

In particular, Cairns says, "development of new sources of relatively low-cost ethane has spurred capital investment in new steam crackers [used to break down hydrocarbons] that will come on line in the coming years. Much of the associated new production will be destined for export, creating new trade lanes for rail."

Domestic growth remains open for chemical rail traffic, as well. The industries that are customers of the chemical sector are also customers of Norfolk Southern, which kept focus on its carload business.

"Our strong merchandise network is a real asset," Kraemer says. "Those industries — chemicals, metals, agriculture, paper — all benefit from our focus on orchestration and scheduling."

He adds that "every car, regardless of origin and destination, has a trip plan. It is monitored and managed." The focus on manifest traffic is a business decision, he says, but also a legacy of the road's heritage.

Kraemer joined NS at its formation in 1982 after starting at Southern Railway in 1977. "There was a strong service culture there," he said, recalling the railroad's slogan: "Southern serves the South."

Southern's service focus, he adds, was bolstered by a similar approach at Conrail, split between NS and CSX Transportation in 1999. That acquisition folded chemical and refining operations into those railroads' Northeast operations.

BULKING UP ON POLYMERS

CN reports consolidated petroleum and chemicals carloadings and revenues, not segregating chemical carloads. CN's 2014 petroleum and chemical carloads totaled 655,000, an increase of 7 percent over 2013 carloadings.

With all the attention on domestic crude oil, natural gas, and natural-gas liq-

Norfolk Southern GP38-2 No. 5241 switches the Marathon Petroleum refinery in Detroit in February 2010. Charles H. Geletzke Jr.

Union Pacific is a major mover of chemicals, thanks to the many refineries it serves in Texas. Here, GP60 No. 1939 leads a train through Terrell, Texas, in 2008. Steve Schmollinger

uids, such as ethane, as chemical raw materials, it is important to bear in mind that finished plastics are shipped in bulk as pellets in jumbo covered hoppers. In the past, polymer companies and railroads experimented with various forms of "storage in transit," turning the hopper cars into rolling warehouses. The approach to storage in transit — keeping those cars close to the plant, or staging them closer to end-use markets — has varied.

"I would say the storage-in-transit model has been altered somewhat in recent years to focus more on forward positioning to shorten time from order to delivery," Cairns says. "We are seeing our customers take a more pinpointed approach to avoid dead miles associated with backhauling unnecessarily."

Most Kansas City Southern chemical traffic originates on the Gulf Coast, and has an efficient route to manufacturing areas in central Mexico. KCS moved 115,200 carloads of chemicals in 2014, an increase of 2 percent over the previous year. Chemicals revenue was $214 million, an increase of 3 percent over 2013. KCS says it expects an increase in polymer traffic from the Gulf Coast region. Increased polymer production planned in its service area will require expanded storage-in-transit capacity.

KCS's third-party transload portfolio continues to grow along the Gulf Coast, specifically in Texas and Louisiana, and especially in Mexico. The expanding automotive industry, as well as Mexican energy reforms, provide a significant growth profile in liquid terminals, which are in development.

In Mexico, natural gas liquids, refined products, and fuel oils are drivers of the liquid terminal expansions. KCS has worked closely with transload partners to create strategically located liquids transload terminals. Also, KCS has provided land and financial support toward the development of lubricant and fuel-oil terminals in Mexico.

Polymers are a solid franchise for NS, albeit primarily as a receiving road. The automobile industry is one of the major consumers of plastics in the entire economy, and automakers have expanded vastly in the Southeast in recent decades. There is also strong consumption of polyethylene terephthalate bottles and polyvinyl chloride pipe, also known as PET and PVC.

"We are still seeing storage in transit for polymer cars," Kraemer says, "but they seem to be more stored near the manufacturing origin. They try not to ship backward, so they [choose] yards closer to the producer location versus destination."

TRANSLOADING ACCELERATES

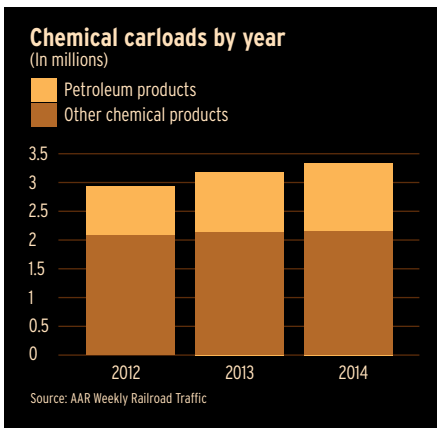
Bulk distribution and transfer have been growing for NS, Kraemer says.

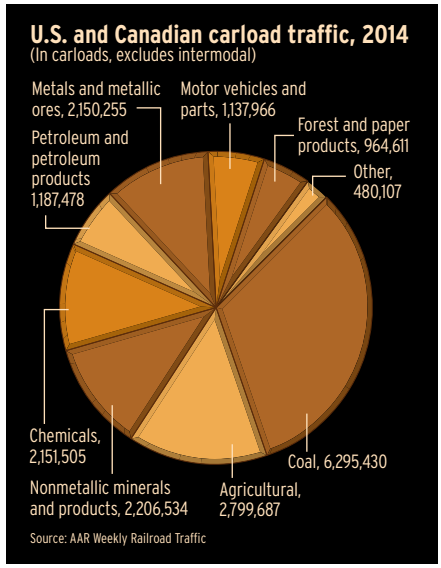
"We have about 30 Thoroughbred Bulk Transfer terminals, as well as a broad network of third-party terminals," he says.

"If there is not one of those convenient for a move, then there are several private companies that we work with as well. There is a very good spectrum of facilities and capabilities for customers that are not directly rail-served." In the last two years, NS has opened bulk transfer facilities in Columbia, S.C.; Knoxville, Tenn.; and Norfolk, Va.

Proprietary or private terminals only handle shipments for a designated carrier or shipper. Third-party or commercial terminals handle any customer, given space and appropriate capabilities.

The Savage Cos.' terminals range from several large unit-train terminals to about 40 chemical transloading operations. A significant portion of those are operated under contract in the East for CSX. When NS and CSX divided Conrail, Savage acquired the majority of Conrail's Flexi-Flo facilities, now called Transflo. Materials primarily flow in by rail and out by truck, but some





CHEMICAL INDUSTRY AND RAILROADS FORM 'RESPONSIBLE' PARTNERSHIP

Chemicals and their transport are often a source of public and environmental concern. Railroads and the chemical industry work on two fronts to address these issues.

One program is Responsible Care, created by the chemical industry's trade association, the American Chemistry Council. Responsible Care is a voluntary initiative to protect the environment and improve performance related to health, safety, and security.

Chemical manufacturers that are council members — all major companies and the vast majority of others — are required to implement the program as a condition of membership. Railroads, railcar makers, terminal operators, and third-party logistics firms are among the non-manufacturing companies that can become Responsible Care partners. They voluntarily commit to the same codes of management practice, to the extent applicable. All seven Class I roads in North America are Responsible Care partners, as are many car manufacturers and logistics firms.

At each participating company, whether a manufacturer or supply-chain service provider, senior managers sign onto the program's guiding principles. The companies' officers commit to annual public reports on relevant health, safety, and security performance measures.

Members and partners also implement prescribed management practices in three "areas of emphasis" — product safety, process safety, and security — on a set timeline. And members and partners must complete a third-party certification of their health, safety, and security management system. Certification must be renewed at least once every three years for the headquarters as well as a requisite sample of operating facilities.

The partner program today comprises more than a hundred companies, primarily railroads, motor carriers, terminals, warehouses, container manufacturers, inland marine carriers, and logistics providers. Beyond the Class I railroads, the major carmakers and more than 20 rail-related logistics firms are partners.

Working in concert with manufacturers, Responsible Care partners identify hazards and risks associated with council-member product lines within their respective operations, then work to jointly define practices to mitigate and manage these risks. Manufacturers and railroads also collaborate on emergency responder training through a program called Transportation Community Awareness and Emergency Response, or TRANSCAER.

"Bringing shippers and carriers together means we are able to provide their knowledge, resources, and expertise to the first responders in the communities through which the materials move," says Donna Lepik, American Chemistry Council staff executive for TRANSCAER. "The training is important, but it is just as important to bring together the people who will be responding if there is a problem. Everyone gets to know each other, and that builds a level of trust, understanding, and cooperation."

The program is being expanded to include crude-oil shippers and carriers. That expanded training will be rolled out to 17 states this year.

"There is never a cost to the first responders," Lepik says. "The training is both online and in person, and is completely funded by industry through the council. The responders get education on chemical substances, transportation equipment, and best practices in an emergency." — *Gregory DL Morris*

shipments move in the opposite direction. Savage also recently won a transloading contract for fueling of locomotives.

"The railcar becomes a warehouse on wheels," says Savage's Alexander. "Transloading brings the benefit of rail economics to companies without the capital costs and maintenance expenses of rail infrastructure."

Alexander says those benefits will become more important to more shippers as there are fewer long-distance truck drivers and the highway haul becomes more expensive for long distances. Echoing the railroads, he also expects growth to come from domestic oil and gas production.

"Natural gas and liquids are fuels and feedstocks for chemicals," Alexander says, "and the U.S. is in a very favorable economic position as a result for chemical production." Because it touches so many industries, he believes "the chemical industry is often a better indicator of the economy as a whole than some government statistics."

CN sees growth in transloading, Cairns says: "We have been very active in the space with our CargoFlo team as well as working with third-party transloaders. We are there to help fill a customer need when a transload site can help balance efficiency of last-mile delivery by truck with long-haul economics of rail."

One of the major differences between chemicals and other rail commodities is that the vast majority of the car fleet is owned or

A crew member digs out a switch as a CN local works in Martins, Ontario. The tank car was picked up earlier from Stepan Chemical in Longford Mills, Ont. Wayne D. Shaw

leased by shippers. That makes sense, considering many hazardous and even innocuous chemicals need specialized tank cars. The cargo does not lend itself to pool cars the way sand, lumber, or paper do.

As a result, chemical shippers are adamant about full-cycle or orbit times for their cars. Getting their empties back is just as important as getting loads to the customers.

"We have a new team at CN dedicated to working with private-car customers to proactively smooth out empty equipment flows," Cairns says.

"Getting the right car to the right place at the right time is imperative for our private-car customers. Our new pipeline management group helps select customers manage their fleets more effectively. Our focus is on reducing dwell and managing diversions to avoid congestion, with an eye on not missing loads because the right car was not available. A missed load is lost revenue for CN, but more importantly a potential lost sale for our customer."

DRIVING SAFETY AND GROWTH

The effort to deliver cars in a timely fashion dovetails with an emphasis on safety, the most important and overarching mandate in chemical movement.

"Certainly, the most impressive advances are coming in car-tracking technology," Cairns says. "We are seeing some industry leaders on the cutting edge deploy GPS tracking and other devices on tank cars.

This is the next frontier in safety and we are happy to work closely with our customers that are cutting the trail. We recognize there is a cost to upgrade fleet, and [we] reward those customers who ship modern cars with advanced safety standards with CN."

Knowing the exact location of cars containing hazardous materials has many advantages. It helps shippers and railroaders monitor movements and advise authorities of specific risks if there is any complication.

Cairns adds, "In our continued effort on safety and to continue our customer collaboration under Responsible Care [see "Chemical Industry and Railroads Form 'Responsible' Partnership," page 44], CN instituted a program in 2011 by which we offered differential pricing for toxic inhalation shipment using a new 'interim' car. That was deemed safer by the industry, compared to the legacy cars in service.

"We recognize the capital burden for our customers. That program was to encourage more customers to seek equipment replacement sooner rather than later, in an effort to retire the legacy car quicker and make our network and its surrounding communities that much safer."

For KCS, the latest safety development is the AskRail smartphone and tablet application, developed by the rail industry and built by AAR and Railinc. The app provides first responders an alternative method to look up hazmat shipping-paper information, carrier contacts, and emergency handling information. By the middle of this year, first responders will also have the ability to access train consist information.

Also, KCS is developing a database of all emergency responders and response agencies along its routes, including but not limited to paid and volunteer fire departments, local emergency planning committees and other emergency management agencies.

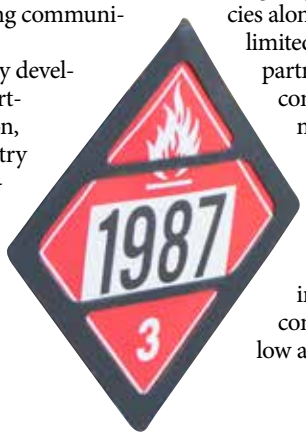
That data will be used for training responders, disseminating hazmat traffic data, drills, exercises, AskRail deployments, TRANSCAER training, and local emergency planning committee meetings. It will also allow a better understanding of local responder capabilities and develop plans for best emergency responses. The new database will improve communications with emergency responders along KCS' route and allow for more effective response.

Safety will be vital if chemical traffic expands, as NS's Kraemer expects.

"We already have a very strong customer base," says Kraemer, "and looking at the domestic energy outlook, there is likely to be significant growth in chemical manufacture and exports. The diversity and broad base of the chemical industry is one of its great strengths, and it has a very solid outlook." T

GREGORY DL MORRIS is an independent business journalist, based in New York. He was based in Houston as Gulf Coast Bureau Chief for ChemicalWeek magazine 1991-95, and wrote the November 2004 Trains *cover story on chemical traffic.*

Greenville & Western units handle an ethanol train at a Kinder Morgan transloading facility in Cheddar, S.C., as power for the train's move on CSX awaits duty. Reginald McDowell

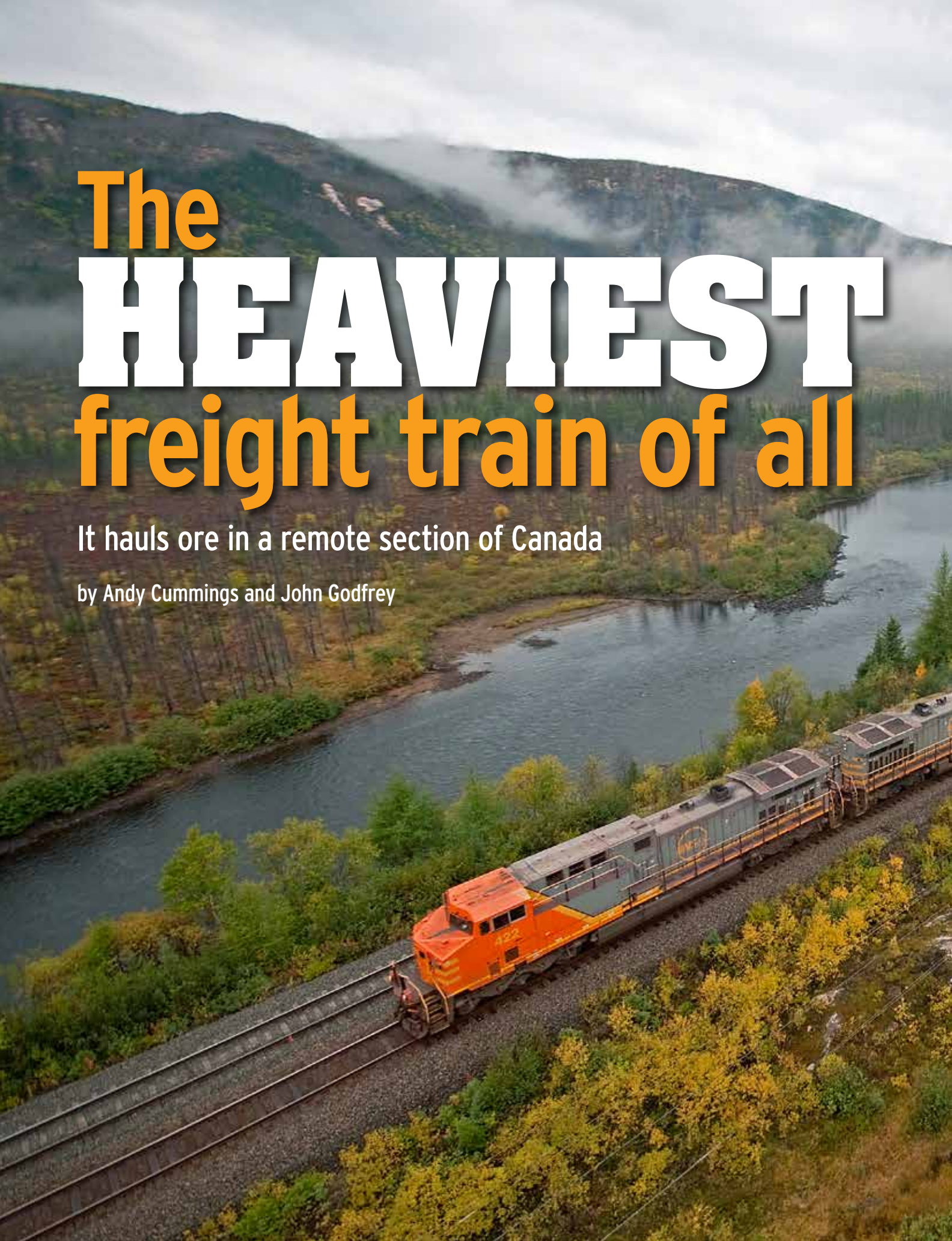


Placards, like this one for alcohol, identify car contents in an emergency. Trains: David Lassen

The HEAVIEST freight train of all

It hauls ore in a remote section of Canada

by Andy Cummings and John Godfrey



A 240-car iron ore train rolls south of Nipisso, Quebec, on Sept. 21, 2011.
Andy Cummings

As seen from the cab, a hopper car full of iron ore rides the rails of the Quebec North Shore & Labrador, the operator of North America's heaviest freight trains as of late 2011. Today, the railroad is not as busy as it was when TRAINS visited. Andy Cummings

Engineer Richard Simoneau is frustrated. The shipping managers at the Carol Lake iron ore mine and processing plant gave him their best estimate of his train's weight, but a firm spanking from behind within minutes of departure tells another story. "This train doesn't weigh what they said it does," Simoneau says.

Indeed, the weigh-in-motion scale that Quebec North Shore & Labrador train PL-480 crosses minutes later pegs the 244-car train's weight at 31,955 tons from lead drawbar to marker. That's nearly 1,000 tons less than the average "Carol Lake long" train and evidence that the mine called on its front-end loaders to fill part of the train with reclaimed ore pellets. For engineers like Simoneau, who are accustomed to full trains of near-perfectly profiled loads from the Carol Lake loadout, even such minor variations call for changes in how they use their throttle and brakes.

To Simoneau's credit, only the slack action is noticeable in the cab of AC4400CW No. 422 during his eight-hour, 132-mile run to Mai, Quebec. He smoothly guides a train weighing roughly the same as two loaded Powder River Basin coal trains.

QNS&L's biggest trains of 240 cars in length operate with two units up front and a third behind the 164th car. Computer simulations helped establish this as the ideal setup, and they are among North America's heaviest trains — if not the heaviest. They typically weigh in at 34,000 tons. A typical unit coal train weighs in at 16,000 tons.

Think of what Simoneau is doing as railroading concentrate: a version of railroading that reaps all the physical advantages of steel wheels on fixed guideways, but suffers few of the concept's drawbacks. His train moves as a unit, and will need no classification or block-swapping. There will be no cars to pick up or set out. The steepest grade it encounters will be 0.4 percent, and it'll traverse just four public grade crossings on its 263-mile journey.

The railroad, though located in a remote section of Canada, is well-known as an innovative pioneer — an early adopter of cabooseless operation, distributed power, and welded rail. The railroad still has that cachet as a risk-taker and innovator with technologies both advanced (a GPS system that warns the engineer when he's approaching another train) and primitive (snowshoes) in locomotive cabs.

QNS&L began engineer-only operations in 1996. The following year, it convinced Transport Canada to waive a rule limiting engineer-only trains to 150 cars. The railroad subsequently began running trains twice as heavy as other railroads' unit trains — with half the crew.

The railroad's biggest customer is its parent, Iron Ore Co. of Canada, which international mining giant Rio Tinto majority-owns and manages. Surprisingly, the railroad's second-largest customer is one of Rio Tinto's primary competitors in ore production: Cliffs Natural Resources. Because the railroad crosses provincial boundaries, it is a federally regulated common carrier that cannot deny service. Cliffs, which operates two mines, depends on the railroad to haul iron ore concentrate.

"They are competitors to Iron Ore Co., but they are clients to QNS&L," explains retired rules administrator and instructor Jacques Clavette, adding that shipping Cliffs ore helps defray Iron Ore Co.'s cost of rail operations, so it's not without benefit. "We're not transporting their ore for nothing," he says. This has been the reality for the railroad since 1962.

It takes a QNS&L ore train roughly 48 hours to make a round trip, including load and unload times. At any given moment, the railroad generally has 14 trainsets moving, loading, or unloading.

All ore trains operate with retainers on all cars set in the "slow direct" position. This is due to the trains' heavy weight and the steep 15-mile descent between Bybee and Tika. Slow direct-set retainers keep a car's brakes partially applied for a minute or longer after an engineer releases them, giving the locomotives' air compressors time to recharge for the next set.

Engineers cut the railroad's right-of-way into the Canadian Shield using technology unavailable to previous generations of railroad builders. Aerial surveys preceded a route selection, with contracts let in September 1950. Before the railroad came a series of airstrips so track material could arrive by

A 240-car iron ore train winds down the Moisie River Canyon near Tellier, Que., on May 4, 2010. The power is a pair of EMD SD70ACes. QNS&L

plane. The completed railroad would accept its first load of iron ore at Ruth Lake, N.L., just outside its Schefferville, Que., northern terminus, on June 29, 1954.

Workers had to blast a path for the railroad into the walls of the Moisie, Nipissis, and Wacouna river canyons. The route twisted around 8-degree curves and forced northbound trains to tackle a grade in excess of 2 percent. But for southbound (read: loaded) trains, grades remained moderate.

As a consequence, ore trains ran heavy from Day 1. Newly purchased GP7s ran as quartets, pulling 135 empties from the St. Lawrence River dock, then returning with 125 loads.

In the railroad's early years, the limiting factor was the risk of train separations. Put too much weight behind the pulling locomotives, and you raise the strain on the drawbars and knuckles that hold the train together. If one of these links breaks, the train snaps apart and goes into emergency. Repairs can take hours and, in cold weather, recovering a train's air can take an hour or more. The resulting operational headaches can quickly get costly.

In 1965, North Electric of Galion, Ohio, introduced Locotrol, offering railroads the chance to distribute locomotives throughout a train. The problem of the gigantic trains was solved.

Jacques Clavette, the retired rules administrator and instructor, hired on in 1970. That year, the ore road installed Locotrol on a GP9 for testing. Later, it modified ore cars to accept radio signals and pass them to an adjacent diesel via m.u. cables. "You could put any engine in the middle," he recalls. "It didn't matter, because the electronics were all in the car. We tested for two to three years. In the old days, it was trial and error." The trials included operations at 265 cars, and the errors included a single trip with 300 cars of ore from the mines. Clavette monitored the experiment from the train's caboose.

"I don't know how many times he broke apart on the trip down," recalls Nick Trépanier, the railroad's group manager for transportation and interim superintendent.

How do the railroad's operations stack up against other heavy trains worldwide?

An Australian ore train in 2001 with 682 cars, weighing in at 90,390 tons ran 172 miles with eight General Electric units under the control of one engineer. Regular trains are about one-third this size. A South African freight railroad regularly operates trains of up to 40,000 tons in 3-foot, 6-inch "Cape gauge."

On a regular basis, Brazil's Vale mining company runs iron ore trains of 330 cars or about 46,000 tons.

When this report on the QNS&L was written in November 2011, the railroad and the steel business were thriving. Today, the situation is much changed, with demand for steel off significantly. The 34,000-ton trains are no more, but one day, when times are improved, don't be surprised if they are back on a lonely but innovative railroad in the remote far reaches of northeastern Canada. ⊥

LUMBER CENTER

BEAM to prosperity

The ups and downs of hauling lumber

by Roy Blanchard

Canadian National knows lumber. CN is the No. 1 North American railroad carrier of dimensional lumber, plywood panels, and oriented strand board, a material more commonly known as OSB — an engineered wood particle board formed by adding adhesives and then compressing layers of wood flakes into shapes. The broad lumber category at CN comprises these three commodities and represents just under half the carloads in the so-called forest products commodity group, which includes all kinds of paper, cardboard packaging, and even the wood chips and logs that are basic raw materials for making paper.

We'll focus on lumber and wood products used in the building trades, with CN as the exemplary carrier, not only because it's the biggest in the business but also because it's considered to be one of North America's best-run railroads.

CN handles about 155,000 carloads of lumber every year, but it's a tough business. Just how tough is evident from the Association of American Railroads' Rail Time In-

A Canadian National train rolls through Sussex, Wis., with lumber loads, left, that are wrapped in a plastic for protection, above.

Left, Nolan Wallenkamp; above, TRAINS: Drew Halverson

A string of empty centerbeams rolls north on a CN train at Sussex, Wis. Some days this block grows to 80 or more, returning for another load of Canadian lumber. TRAINS: Brian Schmidt

dicators publication covering North American rail carloads. Charts show how the one-month record of 11,000 lumber and wood products carloads in April 2006 has never been matched since.

The reason? It all comes down to housing starts, which hit a peak of more than 2 million a month in early 2006 and dropped steadily to 540,000 by mid-2009. The AAR cites a 95 percent correlation between lumber carloads and housing starts, which explains why car counts in mid-2009 were half what they had been at the peak. By the end of 2014, lumber carloads were double what they were at the low point, but they were still only two-thirds of what they had been in April 2006. (The lag between railroad peak and housing peak has to do with the lag between when lumber is received and the actual "housing start.")

The AAR study shows U.S. housing starts by region, from peak to trough to today. The South, essentially Virginia, south to Florida, and west through Texas, has posted the most annual starts going back to 2006, and the Northeast — from Maryland north to New York, and New England — the fewest. The South has recovered the most while the Northeast stays depressed, and starts have only slightly improved in the rest of the country. So where are they getting their lumber? Canada is a major source.

A waybill sample database shows British Columbia originates more carloads of lumber than any other province in Canada or state in the Lower 48, some 80,000 cars a year. Drilling down by destinations, 70 percent of all lumber carloads originating in British Columbia are headed to the arc from Virginia, south and west to Texas, and continuing into California and Oregon. And CN is the dominant originating carrier for lumber going there.

Last fall, JJ Ruest, CN executive vice-president and chief marketing officer, told the investment community that demand for lumber and panel products would be "in line with U.S. housing starts." As 2015 began, CN reported that demand and shipments for lumber and particle board were encouraging; engineered-wood mills that increased production last year are seeing even more orders now. Housing starts are a big factor: December 2014 starts in the U.S. increased 5 percent to more than a million units from the December 2013 figure.

Readers will recall that last year the newspapers were full of chatter about railcar supply problems. Customers were sitting on cars for long periods between placement and release, whether for loading or unloading, exacerbating the situation. The lumber industry newsletter, Random

Empty centerbeams scream through the marshlands in Theresa, Wis., on CN's Waukesha subdivision. TRAINS: Drew Halverson

Lengths, last December cited car supply in Quebec as a particular challenge.

Has there been progress? Yes. CN Vice President for Industrial Products Doug MacDonald says: "The 2014 car supply-to-demand variance for customers situated in Quebec has been resolved. Car orders in Quebec in the fourth quarter of 2014 were nearly double what customers had forecast in the first quarter."

It turned out that customers were over-ordering lest they be caught short in the 2014-2015 winter, as they had been the previous year when bitter cold and seven-foot snow drifts in places like Edmonton killed cycle times, causing car shortages in east Quebec. (I know what it was like: I was on VIA's *Canadian* eastbound through there in February 2014).

"CN did a few things different in 2014 to help address car shortages and cars dwelling at destination waiting to be unloaded," MacDonald says. "While we know that weather and rail congestion played a part, CN has instituted a dwell program at destination to prevent additional cars from being shipped to a congested location.

"When we see CN cars dwelling on other railways for more than 13 days at destination, we prevent additional CN-originating shipments from going to that location via a bill of lading rejection. Customers receive 48 hours notice before the destination/consignee is added to a congestion list," he says. "Once the cars dwelling over 13 days are unloaded, CN will then remove the customer-station designation from the list so our local customer can resume shipments to that receiver."

For example, say there's a receiver on the Union Pacific in Fort Worth, Texas, who sits for 13 days on a centerbeam flatcar of plywood that Canadian National originated in Edmonton, Alberta. CN won't send the receiver more cars from any CN origin until the customer cleans up his act. The business of not unloading promptly isn't limited to lumber, either.

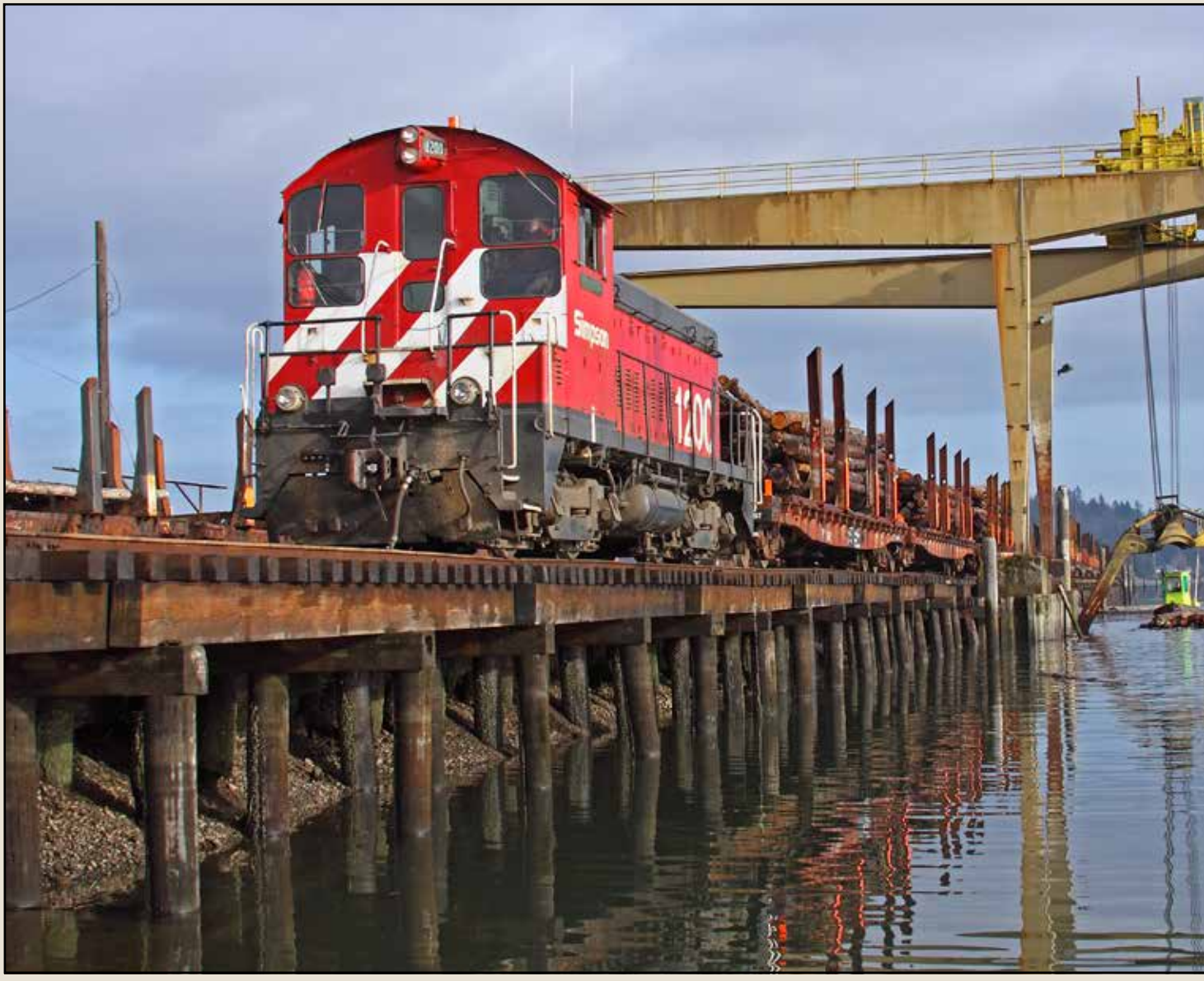
There was a time when grain receivers at ports didn't work weekends, adding at least two days to car-cycle times. And since railroads are networks, what happens at one node affects every other node. Slow turns for grain cars at Western ports keep lumber empties from the west from getting to loading docks in the east; a crude-oil train destined for Delaware, released a day late in Alberta, can affect on-time arrivals of ethanol in Montreal. That's why railroads get cranky about customers not turning around equipment.

But customer behavior is only part of the car-supply equation. "CN initiated an improved order process for centerbeams and boxcars starting in late 2014," MacDonald says. "We divided the continent up into high-velocity and low-velocity destinations." So rather than just loading cars in a random sequence, customers order and load cars by destination — filling the high-velocity destinations first and filling in with low-velocity destinations between high-velocity loads.

The motivator for the originating customer is CN's guarantee to fill every high-velocity order to promote faster car cycles and greater car supply for customers. CN then allocates cars accordingly and fills the low-velocity orders with equipment not allocated to the high-velocity lanes. By setting up high-velocity and low-velocity loads on a weekly basis, origin customers get an assured number of cars to meet supply-chain commitments, and CN can increase car-miles per day and move more wood with the fleet on hand.

Short lines that interchange with CN extend CN's market reach into places the big railroad doesn't go. A partnership with the Indiana Rail Road puts CN carloads

OTHER LUMBER HAULING OPERATIONS



and intermodal containers in downtown Indianapolis. Genesee & Wyoming's New England Central perpetuates CN's long-time presence in New London, Conn. Reloads on the West Tennessee Railroad's ex-Illinois Central Corinth branch and the Chicago, Fort Wayne & Eastern on the former Pennsylvania Railroad main line east of Chicago add new markets and provide back-haul opportunities to turn cars quickly and efficiently.

Another market expansion is CN's budding export lumber trade, mostly in containers stuffed from centerbeams at the Prince George, British Columbia, distribution center. The export lumber trade is destined mainly to China and represents about 13 percent of total lumber carloads. Since British Columbia is Canada's leading lumber producer, the railroads have short hauls and quick turns for export-lumber cars heading for the Prince George distribution center. Volumes at the end of 2014 were up 15 percent over what they had been in 2013.

CN lumber and wood products typically use three different car types. The 60-foot, 100-ton, double-door — opens to 16 feet — boxcar handles panels, dimensional lumber, and engineered wood products. The 73-foot centerbeam car carries the same products as the boxcar, but is easier to load and unload with a forklift from the ground where one can get at both sides of the car. They are particularly effective in unit-train applications where a train can be parked on a loop track and be unloaded car by car without taking the train apart. And finally are the old, reliable bulkhead flatcars that can accommodate everything that fits in a boxcar, except for being open-top and, unlike the centerbeams, can be unloaded from one side.

Consequently, a lumber loader needs not only to order cars by destination but also by the car type the end user requires to fit the unloading process. But that's not all. The AAR publishes loading rules for every car type and commodity, which CN backs up with graphic training manuals such as "Centerbeam Securing Cables" and "Strap Stowage and Tie-down" for those bulkhead flats equipped with nylon straps to keep loads in place.

Car inspectors will reject cars not load-

Railroads move wood in many ways. At far left, Simpson Timber carries logs at Shelton, Wash. Above, Blue Ridge Southern delivers wood chips at Canton, N.C. CN picks up pulpwood at Ashland, Wis.
Far left, Joel Hawthorn; above, Joseph Hinson; left, Richard Peters

ed according to the rules, thus increasing car-cycle times and decreasing revenue car-miles per day. The situation is particularly critical for centerbeams, because they exist solely for the lumber trade, while bulkhead flats can haul anything from steel I-beams to logs and the 60-foot box is ready to carry anything from beer to shingles to tomato paste. And the CN boxcar fleet of more than 10,000 cars of all sizes — 50-foot cars to 80-foot — doesn't make them exactly scarce.

As for centerbeams, Jim Husband's invaluable RailSolutions Investors' Guide says the demand for centerbeam flatcars is closely tied to the fortunes of the residential and commercial construction industries. "Activity in the residential housing market began to show signs of slowing in early 2006, and by early 2007, activity in this market had come to a standstill.

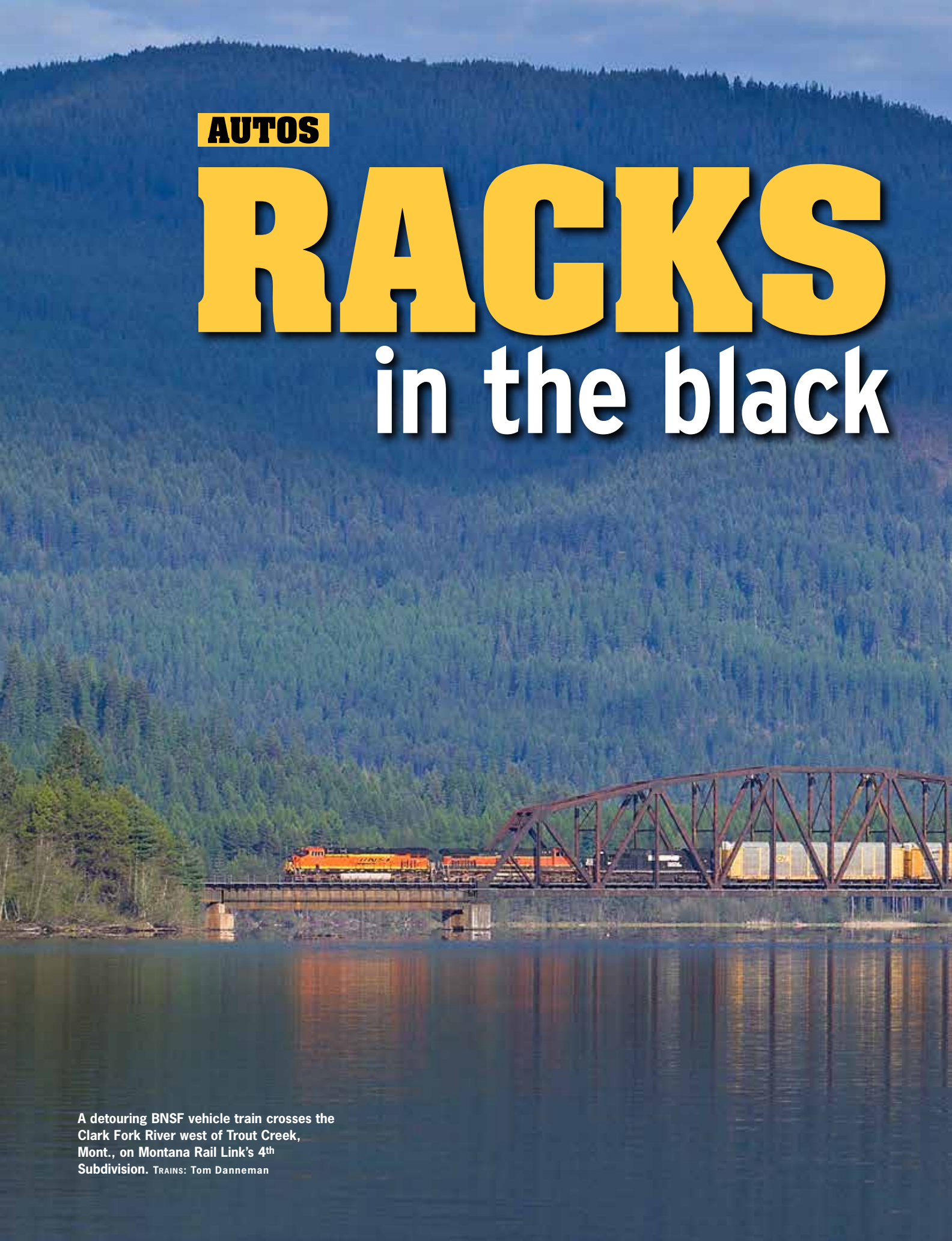
"Full-year 2007 traffic volumes in the lumber and packaged building materials sectors declined by over 16 percent compared to 2006 levels, and demand for lumber-carrying railcars decreased at the same rapid pace." As a result, roughly half the North American centerbeam fleet eventually sat in storage.

Happily, the increased rate of housing starts in 2014 and 2015 means that railroads are pulling cars out of storage for the first time in years, though the number of cars in service and in storage as of late 2014 is projected as sufficient to meet demand, at least until lumber loadings regain the 2006-2007 peak loadings. On the other hand, older bulkhead flats, especially those not fit for 286,000-pound service, are being retired. As of early February 2015, CN had rebuilt its centerbeam fleet to include 2,975 owned cars and 7,179 leased cars.

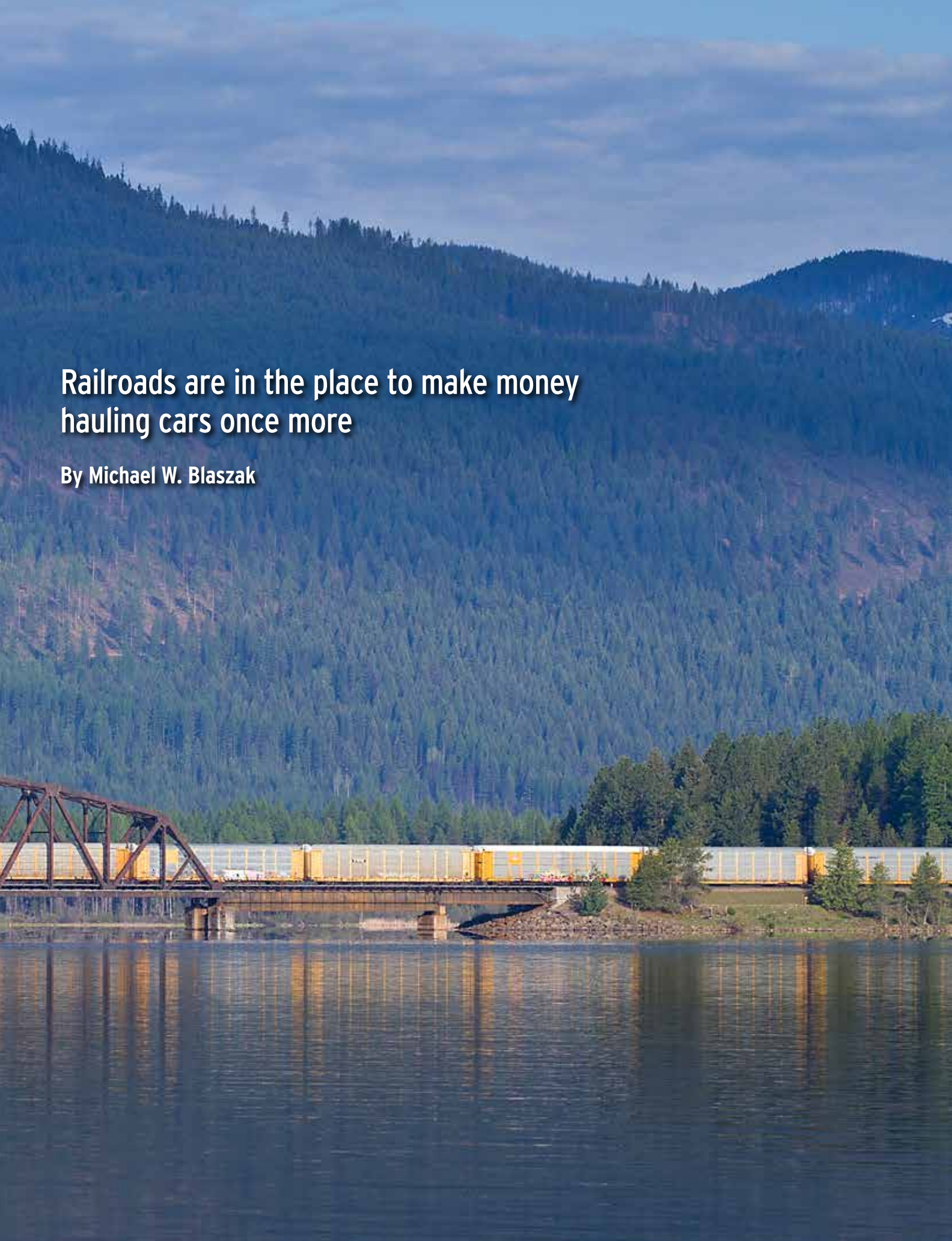
So, the lumber business is on the mend, and the recovery is, to use the AAR's figures, about 95 percent correlated to the heath of the new-housing market. Among North American Class I railroads, CN is the dominant carrier, has the equipment to meet the demand, and is taking steps to encourage customers and connecting carriers to turn the cars without delay. That is quite the comeback story for a commodity that took a huge hit in the Great Recession. See you at the homebuilders' show. T

AUTOS

RACKS in the black



A detouring BNSF vehicle train crosses the Clark Fork River west of Trout Creek, Mont., on Montana Rail Link's 4th Subdivision. TRAINS: Tom Danneman



Railroads are in the place to make money hauling cars once more

By Michael W. Blaszak

A Kia Motors assembly plant crew in West Point, Ga., switches auto racks on March 25, 2011, using an EMD SW9 owned by Locomotive Specialists Inc. The facility, opened in 2009 and served by CSX, is the Korean automaker's first North American plant. Even foreign automakers without decades of relationships and infrastructure in place have integrated railroads into their North American plants. Frank Orona

PHILADELPHIA, *June 21, 1970: Penn Central Transportation Co., the largest railroad in the United States, filed its petition for bankruptcy after the federal government denied its request for an emergency $200 million loan and no private lender could be found. In the succeeding decade, five other Northeast railroads, plus the Rock Island and the Milwaukee Road, followed PC into bankruptcy, while the rest of the industry struggled with minuscule returns and difficulty in raising capital. Only after Uncle Sam reversed course and invested some $7 billion to create and fund Conrail, and enacted the Staggers Act and other regulatory reforms, did railroad service stabilize and return to financial self-sufficiency.*

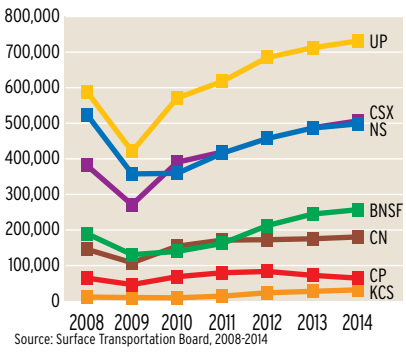
Meanwhile, the recession limited 1970 U.S. auto and light-truck production to 9,639,424 units, but sales by Detroit's Big Three — General Motors, Ford, and Chrysler — plus American Motors, topped 15 million by 1978, despite the impact of the energy crisis and the federal government's 1975 imposition of fuel economy standards, forcing unprecedented shifts in auto design and production. General Motors occupied the top spot in the Fortune 500, and its primacy in the American business world was unchallenged by rivals.

NEW YORK, *June 1, 2009: General Motors, the one-time American manufacturing colossus, filed for protection from its creditors in U.S. District Court at 8 a.m. Eviscerated by competition from foreign brands —Toyota passed GM as the world's biggest carmaker in 2008 — and debilitated by health care expenses for more than a million retirees, GM was toppled by the final blow of 2008's financial crisis, which choked off credit for car sales and limited 2009 production to 8,760,965 units. Chrysler, which had acquired AMC in 1987, preceded GM into bankruptcy on April 30, 2009, while Ford survived the financial firestorm only by mortgaging virtually everything it owned. The U.S. and Canadian federal governments would orchestrate and finance, at a net cost of about 23 billion taxpayer dollars, the creation of a new General Motors, keeping only the company's strongest brands under a cost structure competitive with other carmakers, while management of Chrysler was vested in Italian vehicle manufacturer Fiat.*

Meanwhile, nearly 30 years of partial deregulation, consolidation, and improved management have produced a strong and secure North American railroad industry. On Nov. 3, 2009, Warren Buffett's Berkshire Hathaway Corp. announced that it would purchase the 77.4 percent of BNSF Railway it didn't already own at a price 31.5 percent higher than its previous close. The deal, which closed in 2010, represented a $34 billion vote of confidence in the future of American railroading.

Yes, the fortunes of the auto and railroad industries have reversed in the past five decades, but one thing hasn't changed during that time. Railroads and vehicle manufacturers remain mutually dependent on each other. A substantial fraction of North American vehicle production was shipped by rail in the 1970s, and about 70 percent of it is shipped by rail today. And U.S. railroads depend on ship-

REBOUNDING AUTO CARLOADS: 2008-2014



Source: Surface Transportation Board, 2008-2014

ments of finished motor vehicles and associated auto parts for about 7 percent of their gross revenues.

A COMPLEX OPERATION

When that new car or truck rolls off a truck carrier at your local dealership, odds are it's just completed a long trip from the assembly line by truck, rail, and perhaps water. The manufacturing of motor vehicles has become a global business, as developing nations demand more cars while automakers seek economies of scale. Toyota builds the popular Corolla, for example, in 13 countries, including the United States and Canada. As for which plant makes the car you buy, that depends on transportation costs, transit time, tariffs, and local customs. (A right-hand-drive vehicle isn't very marketable where people drive on the right side of the road, for example.)

In North America, automobiles and light trucks such as pickups and vans are produced in 68 different manufacturing plants, with five more plants scheduled to open by 2016. In addition to facilities in Detroit, the Big Three at one time had U.S. assembly plants on the East and West coasts, close to major consumer markets, but virtually all of them have closed since the 1970s. Today, the majority of vehicles sold in North America are built within an industrial core extending from Ontario through Michigan, Indiana, Illinois, and Ohio, down into the South, from Georgia to Texas, and on through Mexico to the state of Puebla. Although modern plants can produce different models on the same assembly line — Nissan's Smyrna, Tenn., plant pumps out six models using two lines, one for cars and one for trucks — consumers also now expect an ever-wider variety, from subcompacts to pickup trucks, when they enter a dealership.

Getting the right vehicles to the right dealers quickly and economically is like solving an enormous puzzle. Some vehicles are destined to dealers within a few hundred miles of where they are produced or imported. The cost of loading and unloading them from railcars isn't justified, so they move by truck. This is why the railroads' share of the North American vehicle transportation market isn't likely to climb much beyond the current 70 percent. The rest are driven onto multilevel auto rack cars — trilevels for autos, and bilevels for pickups, minivans, and sport utility vehicles — and transported by rail to an unloading terminal (there are about 150 of them), where they are loaded onto trucks for delivery to area dealers. Most assembly plants have loading facilities adjacent to the premises, though a few aren't rail-served and must truck their production to a terminal elsewhere.

Two SD40-2s on the Terminal Railroad Association of St. Louis shove cars of vehicle frames over the hump at Madison Yard in Madison, Ill. Frames are just one example of the hundreds of auto parts that move by rail in containers, on flatcars, or in boxcars. Michael T. Burkhart

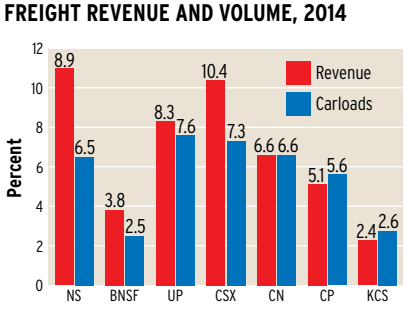
Auto parts made in Detroit are lined up on a pallet ready for movement by truck or rail. Railroads are still competitive for long-haul moves. Matt Van Hattem

Automakers also have to supply those assembly plants with parts that are manufactured off-site, from engines, transmissions, and body stampings to interior trim pieces like seats and dashboards. Railroads once dominated auto parts transportation, particularly when the supply chains for far-flung assembly plants reached back to Midwestern producers. The famous *Blue Streak Merchandise* and kindred trains once run by Southern Pacific and Cotton Belt, for example, fed General Motors' now-closed South Gate and Van Nuys plants in Southern California. Railroads competed even harder to carry parts than finished vehicles, as parts movements are generally more profitable.

But one of the lessons Japanese manufacturers taught the Big Three in the 1980s was the cost-effectiveness of just-in-time parts delivery. As carmakers from Japan began building their own assembly plants in North America — Honda's Marysville, Ohio, plant was the first in 1982 — they brought along their favored parts manufacturers, which built their own plants within easy trucking distance. American producers followed suit by adopting JIT (often jocularly corrupted to "just-in-truck") when designing new plants, which now often have no rail spurs at all and truck docks that open right into the assembly line. As a result, rail movements of auto parts by boxcar have plummeted, with CSX Transportation reporting they constitute just 5 percent of its auto business. Most of the parts that still move by boxcar are too large or heavy to move over the highway efficiently, such as frames, engines, transmissions, and axles.

Norfolk Southern is fighting this trend with its JIT Rail Centers in Detroit; Buffalo, N.Y.; and Dayton, Ohio, where truck shipments are consolidated into boxcars for movement to assembly plants elsewhere on NS lines. NS scored a big win with an agreement to move imported auto parts in containers from the Port of Charleston, S.C., to the BMW assembly plant in Greer, S.C. The moves began in September 2013, taking 20,000 to 30,000 truck movements a year off the highway, even though the rail haul is a short 240 miles. Parts made in the Midwest and Ontario also move by rail in containers to many of the assembly plants in Mexico, while interior trim and other assemblies actually move northward from Mexican parts makers. Union Pacific claims 100 percent of this market between Chicago and Laredo, Texas.

AUTOMOTIVE'S SHARE OF CLASS I RAILROAD FREIGHT REVENUE AND VOLUME, 2014



Source: Surface Transportation Board, 2014

New pickup trucks have a smooth ride inside a covered auto rack traveling on Canadian National in Wisconsin. TRAINS: Drew Halverson

TOUGH CUSTOMERS

When you shop for a new car or truck, you want the best value for your money, and you have many competing options available. You also want your new baby delivered in glossy, pristine condition, without dents, scrapes, or nicks, no matter how many miles you are from the assembly line. The customer's desire for excellence at the lowest possible price reverberates through the dealers to the manufacturers and all of their suppliers, including the railroads, resulting in a relentless pressure on costs. Automakers have a well-earned reputation within the railroad industry as being demanding, challenging customers.

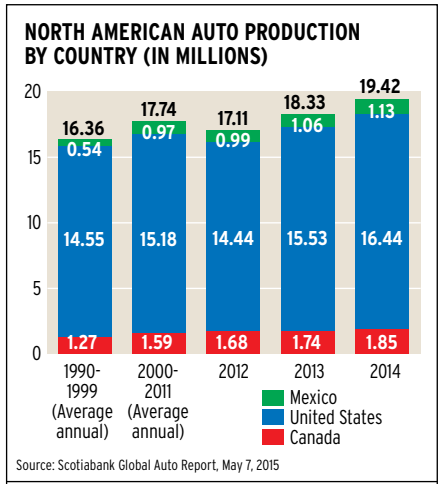
The transportation of motor vehicles and parts by rail has been exempt from regulation since 1993. Negotiations between manufacturers and railroads are conducted out of public view, and there's little information available regarding shipping contracts or rates. It's generally known, though, that Union Pacific dominates the transportation of Big Three products in the West, while BNSF Railway carries primarily foreign brands, whether built in North America or imported. In the East, Norfolk Southern publicly states that it hauls finished vehicles for BMW, Chrysler, Ford, General Motors, Honda, Hyundai, Mercedes-Benz, Mitsubishi, Subaru, Toyota, and Volkswagen, and parts for most of them. CSX doesn't identify its customers, but it does serve 12 of the Japanese, Big Three, and South Korean assembly plants in its territory.

The revenue for vehicle traffic movements, as reported by the railroads, generally averages between $2,300 and $2,600 per carload, with Kansas City Southern off the low end of that scale at $1,876 in 2014. That's about as much as railroads earn on a carload of corn or paper, even though the market value of new cars and trucks is much higher. The figures demonstrate the manufacturers' bargaining sophistication; they've learned to put segments of their traffic up for periodic bidding among competing railroads. Of course, the Big Three's financial deterioration over the decade that led to the 2009 government-sponsored restructuring, only intensified the cost pressure on suppliers.

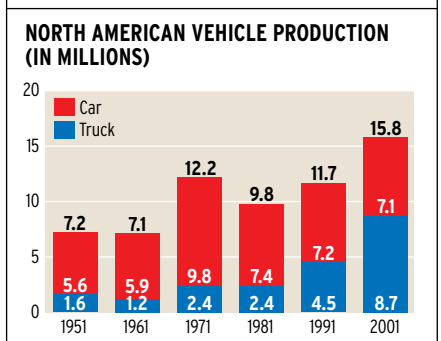
When I visited Ford's Dearborn, Mich., headquarters as a representative of the Santa Fe Railway years ago, my hosts made it a point to show me Ford's rail-movement simulator — apparently a rite of initiation for all railroad visitors. This was a steel platform mounted on a mechanical apparatus programmed to mimic the forces transmitted by train-handling and track to vehicles on auto racks. When the simulator was switched on, the minivan strapped to the platform began to gyrate and shake violently, bottoming out on its springs and then bouncing into the air until it was caught by the tie-downs. The Ford people told me, shouting over the noise, that the simulator could be set to replicate ride quality at any position on a rack, with vehicles at the top corners subjected to the greatest forces. Naturally, that was the position Ford was demonstrating to me.

The message to me and the rest of the industry was clear: Railroads needed to improve their ride quality. In the 1990s, the industry took steps to do just that, with the Association of American Railroads forming an Automotive Quality Team in 1991 to liaise with the manufacturers. Most railroads heeded the car companies' demand to stop sending auto racks over humps, since overspeed impacts on classification tracks were a major cause of vehicle damage. Instead of being mixed into the general flow of manifest freight, auto traffic increasingly transitioned to networks of dedicated rack trains, on routes where traffic levels justified the special handling. This further reduced coupling impacts and slack action, while also chopping terminal-to-terminal transit time and the manufacturers' inventory costs. Improving the trucks and other premium components on rack cars also contributed to a smoother ride.

To support the trend toward standalone vehicle trains, Indiana Harbor Belt converted its Gibson Yard in Hammond,



Source: Scotiabank Global Auto Report, May 7, 2015



Source: wardsauto.com

A Norfolk Southern auto rack train departs Princeton, Ind., on Sept. 13, 2008. The Toyota auto plant in Princeton ships out bilevel auto racks of minivans and SUVs. Most auto racks are limited to 55 mph to avoid damaging the vehicles inside. Michael S. Murray

Ind., once a huge double-hump classification yard, into a vehicle traffic switching hub in 1991. The railroads serving Chicago now run vehicle trains directly into Gibson, where IHB carefully flat-switches the cars into outbound trains for every point on the compass. IHB added 14,000 feet of new track in 2001, then added four more 7,800-foot tracks in 2011, for a total of 23 tracks. Gibson today handles about 600 rack cars daily.

Ford adopted a slightly different approach for its traffic. Ford's Finished Vehicle Distribution System, implemented in 1998, established four mixing centers on Norfolk Southern: Fostoria, Ohio, to serve markets in the Northeast and eastern Canada; Shelbyville, Ky., to serve the Southeast; Kansas City, Mo., to serve the Southwest and West; and Chicago to serve the Northwest and western Canada. At the mixing centers, vehicles from different assembly plants are unloaded and combined into outbound trains for destinations across the continent, allowing dealers to receive their new inventory at one ramp instead of several. Ford's mixing centers considerably shortened the 15-day transit time from plant to dealer, minimizing the number of vehicles in transit and cutting the capital tied up in inventory.

BNSF's vehicle-train network typifies current Class I railroad operations. Most auto rack traffic moves in dedicated trains, running from assembly plant or interchange gateway direct to destination when volume warrants. When it doesn't, BNSF uses its Clovis, N.M., yard, and to a lesser extent its Logistics Park Chicago near Joliet, Ill., as flat-switching hubs, assembling train-length rack consists. Major originating points include Indiana Harbor Belt's Gibson Yard (which BNSF symbols BLU for Blue Island, Ill., near where its crews pick up and deliver), Birmingham, Ala. (fed largely by Honda's Lincoln, Ala., plant), Memphis (near the Blue Springs, Miss., plant Toyota opened in 2011), and El Paso, Texas (a connection with Ferro-

Ferromex ES44AC No. 4607 and SD40-2 No. 3135 lead a northbound Ferromex train of empty and loaded auto racks, auto parts box cars, and double-stack containers climbing the steep grade toward a summit in urban Zacatecas, Mexico. Nathan Muhlethaler

Kia Optimas will leave their Georgia birthplace by train in the lower level of a trilevel CSX auto rack. Special wheel chocks keep vehicles in place. Frank Orona

mex). Eastbound, BNSF hauls imported vehicles from the ports of San Diego, Richmond, Calif., and Portland, Ore.

Destinations include 24 unloading terminals, located near virtually every major city BNSF serves. Auto traffic also moves on intermodal trains (or vice versa) when volume is light, but only rarely on manifest or mixed-freight trains.

STAMPEDE TO MEXICO

The most prominent trend in North American motor-vehicle manufacturing has been the growth of assembly in Mexico since the North America Free Trade Agreement wiped out trade barriers with the U.S. in 1994. Mexico produced about 1.2 million vehicles that year, but by 2014, production had reached 3.2 million vehicles, with about 80 percent of them exported, mostly to the U.S., but increasingly to Europe, South America, and China. Three more plants under construction (including an Audi plant, the first luxury brand to build south of the border), will add another million vehicles to the nation's production capacity by 2016, allowing Mexico, in all likelihood, to become the sixth largest manufacturer of cars and trucks in the world by 2020. Mexico is even more prominent in parts production. By one estimate, more than 40 percent of the average Big Three vehicle today is *hecho en México*.

Mexico attracts manufacturers with its cheap land, proximity to the U.S. market, improving transportation facilities, free trade agreements with 44 nations, and above all a plentiful supply of workers who build quality cars for relatively low wages. Starting pay for a Mexican auto plant worker in 2014 was about $40 a day, while even under the two-tiered wage system accepted by the United Auto Workers during the height of the Big Three's financial crisis, new employees in U.S. plants earn about $14 per hour.

All of this growth makes Kansas City Southern, Union Pacific, and copper mining company Grupo Mexico look very smart indeed. When the Mexican government privatized its state-owned railroad system, KCS and partner Transportación Marítima Mexicana purchased the "Northeast" concession, extending from the U.S. border at Laredo, Texas, to Mexico City and on to the port of Lázaro Cárdenas, in 1997. KCS bought out TMM

Union Pacific SD70M No. 4925 leads an empty westbound vehicle train across the Trinity River Bridge with the Dallas skyline in the distance. A single line of traffic with all the vehicles North American railroads transport annually would be 35,000 miles long. Steve Schmollinger

in 2005, renaming the operation Kansas City Southern de Mexico. Ferromex, which is owned 74 percent by Grupo México and 26 percent by Union Pacific, obtained the "Northwest" concession in 1998, with trackage stretching from Mexico City to the U.S. border crossings of Eagle Pass and El Paso, Texas, and Nogales, Ariz., and on to Mexicali, Baja California.

Both Ferromex and KCSM have benefited enormously from the growth in auto production. Ferromex moved just 38,000 carloads of auto traffic in 2005, but now handles more than three times that number. Its auto-related revenue rose 10 percent in 2012 to $124 million, and the railroad forecasted similar increases for the next three years. KCS did even better, with system automotive revenue up 25 percent in 2012 and 31 percent in the first quarter of 2013. The railroad predicts this growth will continue for the foreseeable future.

Of course, these gains didn't come without a cost. KCSM has invested more than $3 billion since 1996 to improve its Mexican routes and speed up its trains. When the concession began, trains required 70 hours to make the 700-mile run from Mexico City to Laredo. By 2002, transit time had been cut to 34 hours. In addition, KCS spent about $150 million to rebuild 84.5 miles of the former Southern Pacific Macaroni Line between Rosenberg and Victoria, Texas. This trackage, which was surplus to UP after the SP acquisition, shortened KCS's Houston-Laredo route by 67 miles when it reopened in 2009. Ferromex hiked its capital budget from $162 million in 2012 to $370 million in 2013, laying 23 miles of new second main track, 218 miles of 115- and 136-pound rail, and 1.2 million new ties.

The relationship between the two railroads and their automotive customers is complicated and sometimes contentious. Under the terms of the concessions, KCSM and Ferromex were required to grant each other trackage rights to provide competitive service. While they reached an agreement on charges for the use of those rights beginning in 2009, compensation prior to that year remains in dispute. Ferromex also has complained that KCSM wrongfully barred it from access to one assembly plant of a U.S.-based manufacturer in Coahuila (which neither party will identify). If the railroads can't sort out their disputes, the Mexican government will do it for them.

One other cloud on the Mexican horizon is the manufacturers' interest in using ships emptied of vehicles imported from Europe to backhaul cars built in Mexico to the eastern U.S. Volkswagen rotates a fleet of six "Ro-Ro" (roll on, roll off) ships between Emden, Germany, various U.S. East Coast ports, and Veracruz, where they are loaded with vehicles made at VW's plant in Puebla, half going to the U.S. and half to Europe. Limited port capacity at Veracruz likely will prevent the widespread adoption of this strategy, however.

Wallenius Lines' "Ro-Ro" ship *Carmen*, seen in Panama, can hold 7,879 cars or 3,508 cars and 432 buses. These ships move cars between continents. Michael W. Blaszak

THE EQUIPMENT CONUNDRUM

Back in the 1960s, when railroads had lost nearly all of their vehicle transportation business to over-the-road truckers, the auto rack car came into use. It was the industry's main tool to pry its way back into the finished-vehicle market. Able to carry eight or more vehicles depending on

Articulated Auto-Max cars (seen heading east on BNSF at Ludlow, Calif., in 2004) are a common sight on BNSF vehicle trains moving to and from West Coast ports. These largest-of-the-large carriers can hold as many as 26 compact cars. Harold Riley

length, and to be loaded en masse with the use of bridge plates, the basic auto rack design has prevailed ever since.

Over the years, though, changing consumer preferences and economic conditions have created headaches for managers in charge of these long-term assets. In the 1990s, Americans became infatuated with sport utility vehicles that were once only a specialty segment of the business. Most of the auto racks in service were trilevels, unable to clear the taller SUVs. The railroads and rack manufacturers, along with TTX Co., which provides most of the 89-foot flatcars on which the racks are mounted, scrambled to provide enough bilevel rack cars to carry the tide of Explorers, Blazers, and Grand Cherokees pouring out of the assembly plants.

Then came the financial crisis of 2008, accompanied by an oil price bubble that sent U.S. gasoline prices into the $4 per gallon stratosphere. Suddenly, consumers began shunning those gas-thirsty SUVs and buying hybrid cars, if they could afford a new vehicle at all. The railroad industry wasn't prepared for this abrupt shift. Of the 57,000 rack cars in the fleet, more than 38,000 were bilevels. The recession cut North American vehicle production from 15.4 million in 2007 to 8.8 million in 2009. About 9,000 racks were subsequently taken out of service, reducing the current fleet to 13,000 trilevels and 35,000 bilevels, many of them aging and sporting the logos of long-gone railroads.

The recession may have cut auto sales, but North Americans have continued driving, high gas prices notwithstanding, and eventually their cars and trucks will wear out or get totaled in wrecks. By late 2012, the average U.S. car was a record 11 years old, and 20 percent of the vehicle population was a geriatric 16 years old or more. More important, banks and other lenders once again stood ready to finance buyers wanting replacements. Vehicle output bounced back to a pre-recession level of 15.8 million units in 2012, and continued to go strong in 2013 and 2014, with 15.5 million and 16.4 million units sold, respectively.

The railroads' current challenge is how to move all these new vehicles with a substantially smaller and older equipment fleet than they had before the recession, and probably a fleet with too many bilevels as well. Compounding the problem, the growth of the Mexican auto industry means that many new vehicles now have farther to travel than they did 10 years ago, and thus more rack cars are needed to carry them. The railroads' 2014 service problems, with trains moving more slowly due to weather and congestion, have had the same effect.

Automakers, like most railroad shippers, are frustrated that they can't get their products to their customers on time. In April 2014, the Alliance of Automobile Manufacturers complained to the Surface Transportation Board that they "have encountered persistent rail service issues" for years, and that their "greatest logistics problem" is "the carriers' failure to provide a sufficient supply of railcars." More than 100,000 vehicles had piled up at the assembly plants, forcing the manufacturers to truck them to destinations at substantially higher cost. Chrysler has gone even further, purchasing 33 trucks to shuttle new vehicles from its Windsor and Brampton, Ont., plants to Detroit and the Port of Baltimore, and threatening to seek out backhauls from other manufacturers.

Railroads continue looking for ways to squeeze empty miles out of the rack fleet's travels. Back in 1981, railroads obtained authority from the Interstate Commerce Commission to combine their auto rack fleets into a single North American pool, centrally managed to maximize use and minimize empty movements. The pool, currently run by TTX, has nine members (the seven major railroads plus Ferromex and Providence & Worcester, which owns racks and serves the vehicle-handling port at Davisville, R.I.) and also dispatches auto parts cars.

Most cars travel by train before purchase. How long before new cars aboard this CSX auto train at Covington, Ky., will pull up to a drive-through window? Steve Schmollinger

How many vehicles can fit in an auto rack?

Rack type	Primary vehicles hauled	Approximate capacity
Auto-Max	Trucks, SUVs, minivans, automobiles	18-26
Articulated bilevel	Trucks, SUVs, minivans	14-16
Bilevel	Trucks, SUVs, minivans	8-10
Trilevel	Automobiles	14-15
Unilevel	Large vehicles, vans, tractor trailers	2-4

Source: Union Pacific

Now railroads are trying to work these cars harder, by running faster trains and eliminating terminal delays. UP vice president and general manager-automotive Linda Brandl told an industry conference in June 2013 that her railroad is "now moving about four days faster across the fleet [than in 2011], which has generated more capacity." Honda manager of logistics operations Scott Crail told the same conference that his company was loading cars in destination blocks to reduce switching and movements through the congested rail hub of Chicago. Another solution would be to convince dealers to accept deliveries on a 24-hour basis, not just while the dealerships are open, which would permit cars to turn faster. The automakers are working with dealer associations to extend dealer hours.

For the future, railroads want new equipment that will flexibly accommodate both cars and trucks. Several prototypes were developed in the 1990s, with the 20-foot 2-inch tall rack design (able to carry SUVs or minivans on one level) achieving the most success in the marketplace. Greenbrier's twin-unit articulated Auto-Max car, which entered service in 1999, uses a well design borrowed from double-stack equipment to permit trilevel loading of up to 22 taller vehicles. Honda was the first to commit to the Auto-Max, using it on a triangular route over CSX and BNSF to carry American-made cars from its Marysville, Ohio, plant to the West Coast, then return to the Midwest with cars built in Japan. KCS later adopted the Auto-Max to move Volkswagen Jettas and Beetles from Puebla to a mixing center in Houston. Manufacturers like the Auto-Max's smooth ride, and railroads like the car's ability to run at 70 mph, versus 55 mph for conventional racks. However, the significantly higher cost of the Auto-Max and articulated rack cars from other manufacturers have been a barrier to widespread adoption.

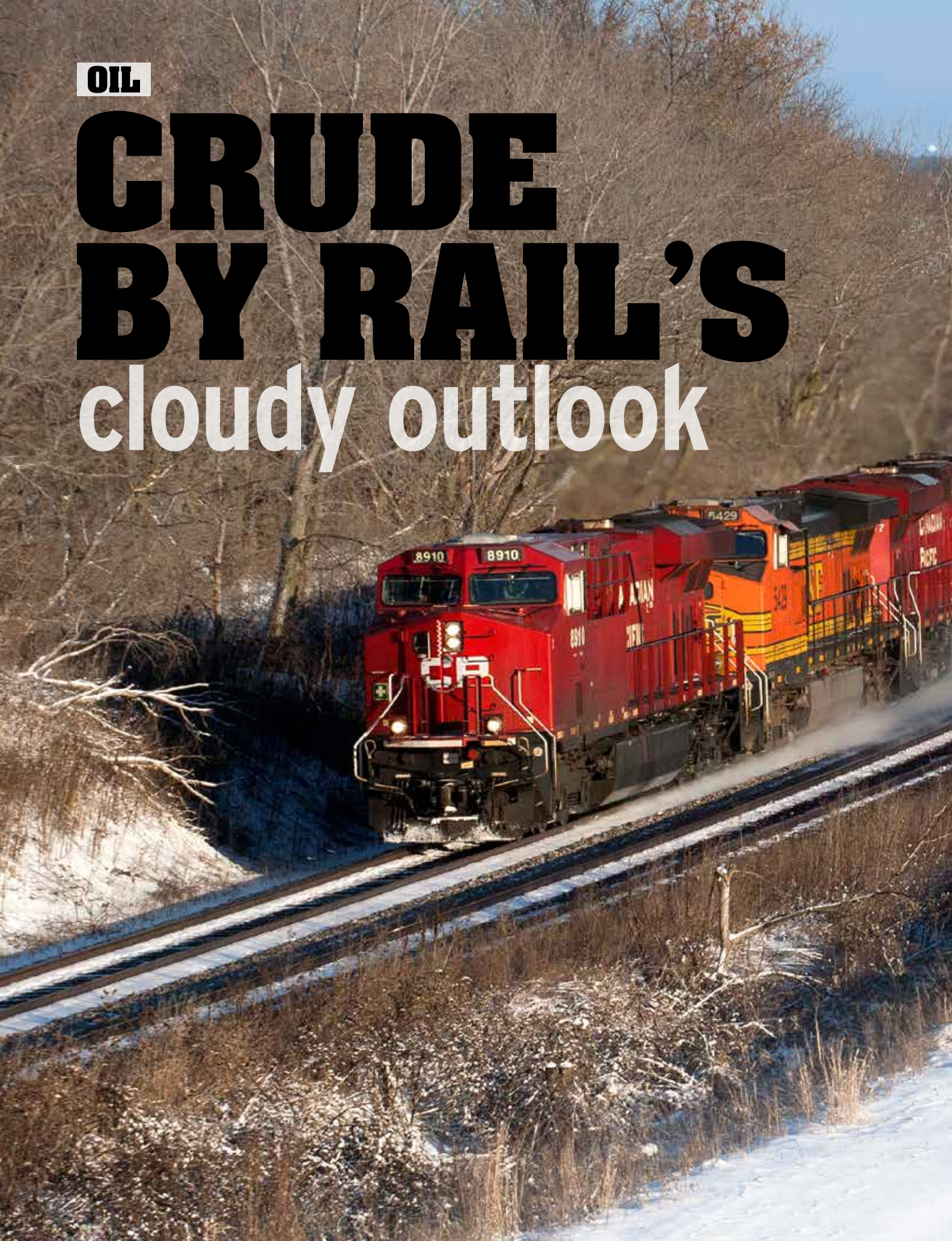
The most recent rack designs can be converted from trilevel to bilevel and back again as consumer preferences change. Union Pacific unveiled its AutoFlex rack in November 2011. Designed by UP employees and built at the railroad's De Soto, Mo., shop, the 90-foot AutoFlex converts from three decks spaced 62-65 inches tall to two decks, one 87½ inches tall and the other 93¼ inches tall. In May 2013, Greenbrier introduced its Multi-Max, which can be changed from a bilevel to a trilevel or vice versa by a trained crew of six in about one shift. But the widespread adoption of any advanced rack design will be slow. Replacing the current fleet would cost somewhere north of $2 billion.

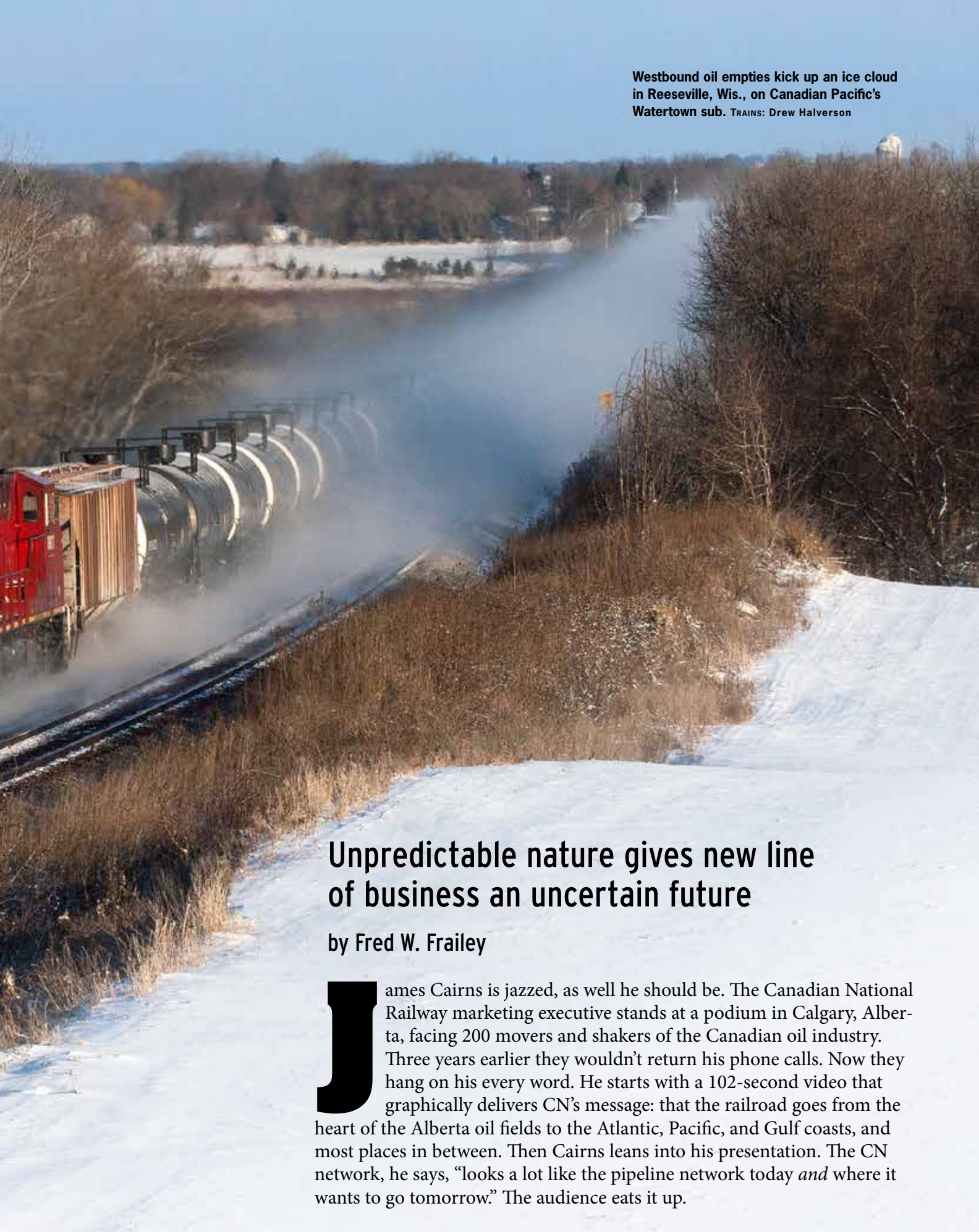
TOMORROW

As long as Canadians and Americans buy cars, the symbiotic relationship between auto manufacturers and the railroads will continue. Urban congestion and high gas prices notwithstanding, the automobile is entrenched in our society, and governments can't build rail lines fast enough to replace it, meaning car and truck manufacturing in North America will likely continue to grow. There is no cost-effective alternative to rail transportation for new vehicles over medium and long distances for the foreseeable future. The next car you buy, and the one after that, will probably make most of its journey to you by train. ℐ

OIL

CRUDE BY RAIL'S cloudy outlook





Westbound oil empties kick up an ice cloud in Reeseville, Wis., on Canadian Pacific's Watertown sub. TRAINS: Drew Halverson

Unpredictable nature gives new line of business an uncertain future

by Fred W. Frailey

James Cairns is jazzed, as well he should be. The Canadian National Railway marketing executive stands at a podium in Calgary, Alberta, facing 200 movers and shakers of the Canadian oil industry. Three years earlier they wouldn't return his phone calls. Now they hang on his every word. He starts with a 102-second video that graphically delivers CN's message: that the railroad goes from the heart of the Alberta oil fields to the Atlantic, Pacific, and Gulf coasts, and most places in between. Then Cairns leans into his presentation. The CN network, he says, "looks a lot like the pipeline network today *and* where it wants to go tomorrow." The audience eats it up.

Trains like this one at Sabula, Iowa, in July 2013, can overcome the lower cost of barge shipments with their flexibility to go wherever demand is highest. Steve Smedley

That was Cairns in autumn 2013. The railroad industry was in the midst of a gigantic coup, wrestling a million barrels of oil each day from the grip of competing oil pipelines. Unit crude-oil trains became the new norm.

But oh my, how times change. The collapse of oil prices in the second half of 2014, from more than $100 a barrel to less than $50, shook the confidence of railroaders as fast as it wiped the smirk off the face of Vladimir Putin, the president of oil-rich Russia. At the same time, fiery accidents emboldened environmental groups, who wish the gooey stuff would never come out of the ground and that we would all be happy someday to again read by candlelight.

Fabricated steel hulls await transformation into tank cars at Trinity Industries' North Fort Worth, Texas, shop. Blair Kooistra

Those accidents also helped spur new federal operating rules including a speed limit on oil trains in urban areas, and played a large part in new, more-stringent federal regulations for tank-car design and construction. The rules, released May 1, 2015, require retrofitting or replacement of the current tank car fleet by 2025.

The rapid rise of crude by rail and the shock the price collapse delivered to the railroad network pose critical questions: Was this an accident of history, a temporary phenomenon caused by the explosive growth of oil fields before pipelines could reach them? Will oil trains disappear as fast as they arose five years ago? Or will railroads find ways to adapt to the unpredictable price swings of crude, and hold onto, and even expand, their market share? The only honest answer to those questions is: Nobody knows.

LAND OF OPPORTUNITY

Oil by rail peaked the first time around in 1943, with 162 million barrels carried. A decade later, the number had tumbled to 28 million barrels and a decade after that to just 5 million. The traffic had moved to pipelines connecting the established oilfields to refineries or to storage hubs, primarily Cushing, Okla. Once built, pipelines are an extremely efficient way to move oil and hard for railroads to under-price. For railroads to have a second chance, something had to change, but the oil industry was static.

Finally, things did change. In the U.S., the change agent was George Mitchell, who died in 2013 at age 94. The founder of Mitchell Energy & Development, he discovered, through years of trial and error, how to marry two existing technologies, hydraulic fracturing and horizontal drilling. That opened up hitherto-impregnable deposits of oil and natural gas, trapped in huge formations of shale rock. Hydraulic fracturing, or fracking, involves injecting water, superhard sand, and chemicals into the shale under high pressure. The injection opens cracks in the rocks, which the sand particles hold open, allowing the oil and gas to escape. Then horizontal drilling allows the seam of shale to be worked its entire length rather than in a single cross-section.

Fracking first began to uncover huge reservoirs of natural gas in the Marcellus and Utica shale formations in Ohio, Pennsylvania, and West Virginia. Then the exploration

company Continental Resources began a hugely successful campaign of fracking for oil in western North Dakota's Bakken shale formation, and the race was on. Trouble was, how to get the oil to refineries?

In Canada, a different set of events upended the status quo. For several decades, oil producers sought economical ways to extract oil from Alberta's aptly named tar sands. The oil is so heavy you can't drill and pump it out. You either must mine it and then extract the oil or heat the substance below the surface and boil it out. By 2010, the technologies for both methods had matured. Then began the search to bring the product, called bitumen, to market. Hint: Raw bitumen won't flow through a pipeline.

So in both North Dakota and Canada, the pipelines weren't ready, and railroads jumped in. But looking five or 10 years down the road, to what effect?

An oil train rolls through Spokane, Wash., on BNSF on Feb. 26, 2013. Increased oil shipments to the Pacific Northwest face significant opposition. David Lustig

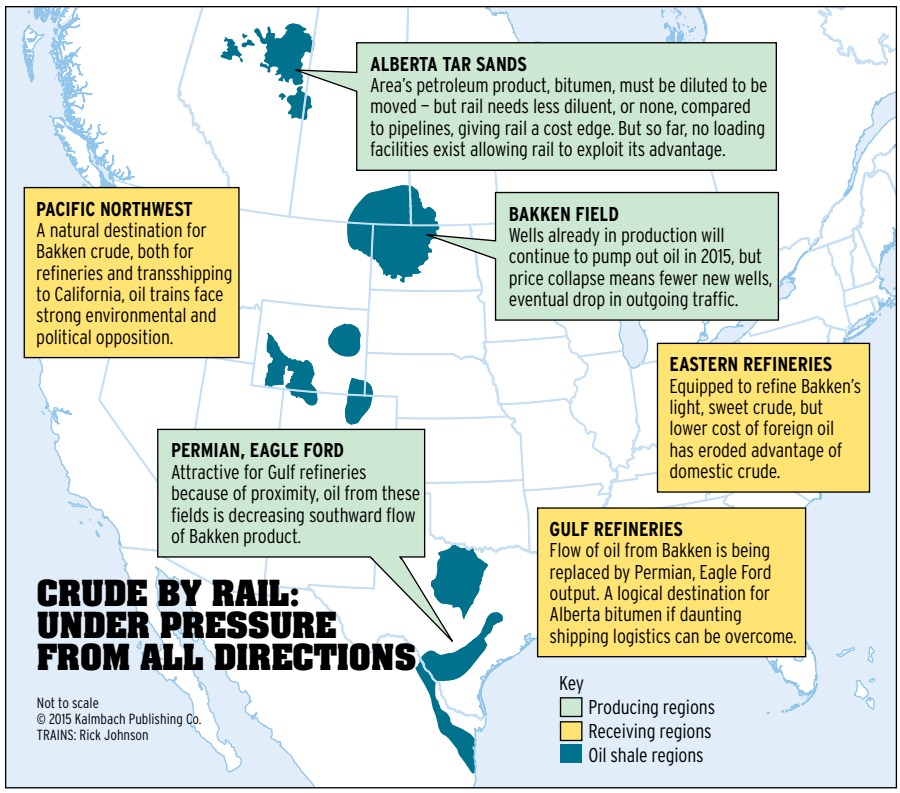
ECONOMIC REALITIES

The efficiency of moving oil by pipelines is unquestioned. So is that of barges. Low-cost inland waterways once dominated the export grain business, with railroads a distant second. Today their market shares are reversed. Railroads, deregulated and shorn of layers of costs, offered grain shippers attractive unit-train rates to *anywhere* that the boat people, who only went *somewhere*, couldn't match. Try moving a river.

That's one advantage of oil by rail: the ability to go wherever the price is right. Valero Energy, the world's largest independent oil refiner, invested close to $1 billion in 5,325 new tank cars (its fleet totals about 10,000 cars) and unit-train facilities. That's a huge commitment. Valero's strategy is to load its tank cars wherever it can find low-priced oil and deliver it to those of its 16 refineries that now use the highest-priced oil. Owning its own equipment, Valero can move its fleet wherever it wishes, driving hard bargains with producers and railroads alike. Perhaps that's why energy economist Philip K. Verleger Jr. calls tank cars "options on wheels."

Rail has other advantages over pipe. You can lease tank cars and establish a unit-train operation in weeks; it takes years to plan and subscribe and permit a pipeline, and years more to build it. Leasing tank cars requires no capital, and the oil they carry pays for the lease; pipelines cost billions. Railroads require only short-term commitments; pipelines demand 10- to 20-year take-or-pay contracts. You can negotiate rates with railroads; pipelines post fixed tariffs. If conditions change — if better opportunities present themselves — you move your unit trains elsewhere; with pipelines, you're stuck.

These are all attractive reasons to consider railroads. Still, in a head-to-head match-up between Point A and Point B, with no complicating factors, pipelines will win. New pipelines are being built, and old ones reversed, to move more oil out of North Dakota and Alberta. Does that mean railroads will lose their foothold? Not necessarily.



But some big changes will occur. For instance, in late 2013 roughly 60 percent of the oil that BNSF Railway moved from North Dakota was destined for Texas and Louisiana, or to barges on the Mississippi River headed to those two states. But by early 2015 that huge flow had shrunk considerably. One reason is new pipeline capacity coming on line. Also, Gulf Coast refineries have a limited appetite for light sweet crude oil, and North Dakota crude is being squeezed out of the Gulf refineries by similar oil from the burgeoning Eagle Ford and Permian Basin oilfields in Texas, which are close by and cheaper to transport.

In 2013, John Miller, BNSF's vice president for industrial products sales, predicted, "In the next few years, you'll see a natural change in the flow" on his railroad, away

Distributed power brings up the rear on a Norfolk Southern train at PBF Energy's Delaware City (Del.) Refinery. Michael S. Murray

from the Gulf Coast and toward the refineries on the Atlantic and Pacific coasts. Refiners in the Eastern and Western states aren't reached by pipelines from oilfields in the U.S. interior and may never be. They once depended on oil bought at the world benchmark price (called the Brent benchmark) and brought to their refineries by ship. As U.S.-produced oil began trading at a sharp discount to the Brent price, refineries on the East Coast were put at such a price disadvantage that some announced plans to close. The refinery closures abruptly ended when oil-by-rail deliveries from North Dakota and Alberta became realities in late 2011.

Altogether, the East Coast refineries, concentrated along the Delaware River near Philadelphia, have a refining capacity of 1.17 million barrels per day and are receptive to the light sweet crude found in North Dakota. The West Coast refineries can process 2.75 million barrels per day, and they are also more sweet than sour (sweet versus sour is determined by the sulfur content of the oil). Combined, that's almost 4 million barrels per day biased toward Bakken oil and rail delivery, if the pricing is right. Daily oil production in North Dakota and neighboring eastern Montana and southern Saskatchewan was about 1.2 million barrels in early 2015. So just do the math. East and West Coast refineries are capable of buying more than three times as much oil as the Bakken shale has produced recently. It was easy to understand the enthusiasm of BNSF's Miller for what lay ahead in 2013. "We see a pathway to handle as much as 1.3 million barrels a day" on the railroad, he said.

Moreover, the Bakken shale is looking more and more like a long-term play. Miller is thinking 50 years. Beneath the Bakken rock is another oil-soaked formation called Three Forks, which has hardly been explored. And below the Three Forks lies a possible third bench.

COMES THE CRUNCH

John Miller has been promoted to other duties at BNSF, and today his enthusiasm (and that of CN's Cairns) has the ring of a premature victory celebration. The first thing to undercut the rosy scenario was a narrowing of the spread between the world (Brent) and U.S. crude-oil prices. Once as much as $25 a barrel, it became almost nonexistent by late 2014.

Presume, for instance, that the cost of Nigerian crude is $105 a barrel and that of U.S. crude $90, or $15 less. It costs, say, $3 a barrel to bring the African oil to the Philadelphia-area refineries, and $12 to rail the North Dakota oil to the same place. In this example the refiners save $6 a barrel by buying the North Dakota oil. But in early February 2015, the spread was a mere $2.50. With transportation costs still roughly the same, it's to the advantage of refiners to get their oil from Nigeria, and this is precisely what the big PBF Energy refinery in Delaware City, Del., appears to have done. It cut its rail deliveries of oil in half. Other refiners may follow as their contracts to purchase North Dakota oil expire.

Next came the price implosion in the

Crude-by-rail trains bound for refineries in Anacortes, Wash., await crews in Everett, Wash., on Jan. 1, 2014. Bill Beers

Protestors, such as this group gathered in downtown Seattle, reflect opposition to increased crude-by-rail activity. Alex Garland

second half of 2014, brought about by weak demand in places like Western Europe and new production in, yes, the Bakken formation of North Dakota. The impact is easy to predict: Probably before the end of 2015, oil production will drop off. Wells drilled by fracturing have heavy production at first, but output trails off fairly quickly. So to increase total output you have to keep drilling more and more wells. Yet at $30 a barrel (the wellhead price in North Dakota recently), it pays to drill only in the sweetest spots. Production budgets for 2015 were being shredded everywhere.

Once you've drilled the well, however, the cash cost of bringing oil up is often modest. Continental Resources, for instance, says its cost of production for wells already drilled is $18 a barrel. So in the short term, producers will attain as much oil as possible, because they have debts to repay and need the cash flow. More oil may come out of North Dakota in 2015 than 2014.

But at some point, with fewer wells being drilled, production will top off and decline. Even if BNSF and rival Canadian Pacific maintain their market shares in North Dakota, their crude-oil business will begin to shrink, probably starting in the second half of 2015.

To this point, we've seen that East Coast refiners may revert to West African oil to save money, and that output from North Dakota is certain to decline until oil prices climb substantially. Both developments would shrink the crude-by-rail market. What about oil going by rail to the West Coast? The potential there remains huge. Refiners in California and Washington had relied primarily on oil brought by ship from the Alaska North Slope, but that output has fallen dramatically as oilfields mature and new fields are taken off limits by the government. Moreover, North Slope oil is pricey.

In early 2015, BNSF delivered more than two trainloads of oil a day to refiners in Washington, and the number was trending up. Destinations were near Anacortes (Tesoro) and Ferndale (Phillips 66), both on BNSF's Bellingham Subdivision near the Canadian border, and in Tacoma (U.S. Oil & Refining). An occasional train goes to Port Westward, Ore., and to a Phillips 66 refinery in Santa Maria, Calif.

Although West Coast refining capacity is more than twice as great as that on the East Coast, for every unit oil train that heads west from North Dakota, two go east. Part of the reason is that refineries are concentrated in the Los Angeles-Long Beach area, and to reach it by rail from the upper Midwest is arduous (2,300 miles) and expensive, requiring trains to go west almost to Portland, Ore., and then south through Klamath Falls, Ore., and over the Tehachapi and Cajon summits.

FOR EVERY ONE UNIT OIL TRAIN THAT HEADS WEST FROM NORTH DAKOTA, TWO GO EAST.

And railroads face an implacable foe in the West: environmental groups. Their websites exclaim "exploding trains!" Their demonstrations block access by oil trains to Pacific Northwest ports and refineries. Their political heft is impressive; politicians from Washington state to California are sympathetic to their causes. Their lawyers are adept at legal challenges to permitting crude-by-rail facilities.

All these forces come into play at the Port of Vancouver, Wash., across the Columbia River from Portland, where Tesoro Corp. and Savage Cos., energy-specialty firms, are seeking to build a rail-to-barge facility. From a transportation perspective, it makes sense to rail oil from North Dakota and then deliver it by barge to California, where refineries could easily offload the product using existing facilities. This would significantly lower the cost of getting oil from the Bakken fields to California.

But close to the rail spur that serves the port is a proposed $1.5 billion development, called The Waterfront, that would contain office buildings, a shopping center, and 3,300 residences. The New York Times reports environmental groups and even the mayor of Vancouver are pushing the developer of Waterfront to get the project underway and at least partly built before the rail-to-barge project is approved by regulators.

The thinking is that The Waterfront's existence would make approval of the terminal more problematic. That the two projects might coexist doesn't seem to enter into anyone's mind. "It's Washington's destiny to lead," the state's governor, Jay Inslee, a Democrat, declared. "We do not want to be addicted to gasoline anymore." As governor, Inslee has final say on the port project. Thus are the battle lines drawn.

With oil tank cars at the front of the consist and double-stacks at the rear, Canadian National train Q116 climbs Byron Hill at Byron, Wis., on Feb. 2, 2014. Matt Krause

CANADIAN EQUATION

If BNSF Railway is the big crude-by-rail winner in the U.S., Canadian National Railway stands to be its equal north of the border. The largest natural landing spot for the oil sands output is the U.S. Gulf Coast. It is the epicenter of American oil refining (9 million barrels per day capacity), and the refineries are geared toward processing heavy sour crude, which is what Alberta produces. This makes Alberta to the Gulf of Mexico the real rail-pipe battleground, and CN is the only railroad that serves both ends.

On the face of it, pipes are a slam dunk. But a couple of analyses show rail with a noticeable cost advantage over pipeline. That advantage arises from the fact that to get bitumen to flow through a pipeline, you have to dilute it with distillate. The flow is 72 percent bitumen and 28 percent diluent, making the pipeline barely 70 percent efficient. Diluted bitumen goes by the nickname dilbit. Plus, you have to buy the diluent and ship it to the pipeline source. And

of course, when it gets to the other end, the refinery gets an ocean of diluent that it must extract and dispose of. "Diluent is the box that bitumen comes in and nobody wants," says engineer Scott Smith of Cenovus Energy. "It just adds transportation costs."

Using ordinary tank cars, you also need dilbit. But if you load the oil into an insulated tank car with steam-heat coils (reportedly, this describes the bulk of tank cars now on back order with builders), you can fill it with "railbit" — that is, 83 percent bitumen and only 17 percent diluent. At the destination, steam heat is applied to warm the railbit to a flowable temperature. These same insulated tank cars can also haul raw bitumen, which must be steam-heated to 200 degrees Fahrenheit to flow.

RBN Energy, an information and consulting company, published in 2013 a rail-versus-pipe cost comparison between the shipping hub of Hardesty in northern Alberta and the Gulf Coast. RBN's Sandy Fielden figured the total cost of transportation just about every possible way. First, raw bitumen in heating-coil tank cars via unit train: $23 a barrel. Second, the same via blocks of cars on manifest trains: $26. Third, railbit (83 percent bitumen) in heating-coil tank cars via unit train: $30.40. Fourth, the same in manifest trains: $39.01. Fifth, dilbit (72 percent bitumen) via pipeline: $42.29. Sixth, dilbit in ordinary tank cars via unit train: $48.55. And seventh, the same via manifest train: $52.72.

Randy Meyer, vice president of business development and logistics for Altex Energy,

On June 22, 2014, a westbound BNSF oil train rolls through Prairie Pothole country west of Cleveland, N.D. TRAINS: Tom Danneman

came to a similar conclusion. He figures the total cost of pipelining oil from Fort McMurray, Alta., to the Gulf Coast at $24.79 to $29 a barrel, versus $22.41 for unit trains of raw bitumen.

What this suggests is that railroads are at an advantage over pipelines between the oil sands and big Gulf refineries, if raw bitumen can be shipped in insulated coil-heated tank cars by unit train.

Still, the problems are vexing. Raw bitumen is immediately diluted to dilbit or railbit in the oilfields for transporting to the rail loading terminals. As yet, nobody has built facilities at the unit train terminals for extracting the diluent to recreate raw bitumen. So for the moment, putting raw bitumen onto unit trains is a dream and nothing more. Raw bitumen that is loaded occurs in small batches and goes onto manifest trains.

In addition, going into 2015, unit train facilities to load railbit in Canada and unload it on the Gulf Coast are only starting to come on line. On the Canadian side, according to RBN Energy, nine unit-train-sized terminals are being built in northern Alberta and western Saskatchewan, and at least a couple will be able to load the pipeline-competitive railbit crude. Canadian National's first unit train from Alberta, to PBF Energy's Delaware City refinery, operated in late 2013, but was put together from several loading locations.

This slow pace owes a lot to misplaced faith in pipelines. TransCanada's Keystone XL was to transport 900,000 barrels per day of dilbit from Alberta and pick up 100,000 of North Dakota crude as it passed through that state. Projected to be in service by now, the XL is mired in politics and still years from completion, if it is ever approved.

Kinder Morgan proposed expanding its 751-mile Trans Mountain pipeline between Alberta and Vancouver, B.C., from 300,000 to 850,000 barrels per day, but is being blocked by a host of First Nations (aboriginals in Canada) tribes that don't want their lands disturbed. Trans Mountain is the only existing pipeline to the Pacific Ocean. Enbridge wants to build a 525,000-barrel-per-day pipeline from Edmonton to near Prince Rupert, B.C., but it is also opposed by the First Nations. Meanwhile, oil sands production is millions of barrels a day, adding to the desperation of Canadian producers.

IN THE OILFIELDS OF TEXAS, NORTH DAKOTA, AND ALBERTA, THIS IS A TIME OF INTENSE UNCERTAINTY FOR RAILROADS.

As a result, Canada's oil industry is about three years behind the North Dakota producers in embracing railroads. "Not until six months ago did producers start agreeing rail is cheaper," CN's Cairns said in 2013. "They'd done take-or-pay agreements with pipelines and refused to admit they weren't right. If we all go pipeline, we have a predictable netback. Now producers are competing based on their choice of transportation. It's very different today."

And then came the price collapse. Oil sands producers have already spent $155 billion to develop the mining infrastructure. Now, new projects are being put on the shelf. Andrew Leach, an economist and professor of energy policy at the University of Alberta, says production costs are at $31 to $39 per barrel in U.S. dollars, awfully close to what oil is fetching in 2015. Yet as is the case in the U.S., those bitumen mines already up and running are still going full tilt. "It really makes no economic sense to bring down production at this point because most of the costs are sunk," an energy analyst told The New York Times this February.

So in the oilfields of Texas, North Dakota, and Alberta, this is a time of intense uncertainty for railroads. What seemed obvious at the start of 2014 — that railroads could get oil to coastal refineries at a price competitive with overseas oil, and that they could compete with pipelines to move bitumen from Canada to the Gulf of Mexico — has been called into question by topsy-turvy changes in the economics of the oil business. For sure, railroads have fought their way back into the business of handling crude oil. Whether they will end up being bit players or major players remains to be seen. Ironically, the outcome will hinge on economic trends, such as pricing patterns, over which railroads have no control. Like the rest of us, railroads are onlookers. T

MOVING CRUDE

A railroad-by-railroad look at Class I involvement in crude by rail

With a Citirail lease unit leading the way, a BNSF crude train arrives at the Port of Beaumont Jefferson Transload Railport in Beaumont, Texas, in May 2014. John Roby

Cutting through the heart of the Bakken shale oil fields, **BNSF Railway** is the undisputed king of oil by rail. Heading west from the crew-change town of Minot, N.D., you encounter six oil-loading loops in 133 miles. Just on the North Dakota side of the state line with Montana, on a branch line connecting the former Great Northern and Northern Pacific lines, is a seventh oil terminal in Dore. In the south of North Dakota, along the former NP main line, are two more unit train terminals, plus a 10th on the branch line to Beulah.

Altogether these loading sites are capable of moving more oil than North Dakota produces.

In early 2015, BNSF was loading about 600,000 barrels daily, which at 70,000 barrels per unit train comes to between eight and nine trains a day. In round terms, 55 percent of that oil was headed to the East Coast, 25 percent to the West Coast and 20 percent to the Gulf Coast or to the oil-storage hub of Cushing, Okla.

The most popular of the 20 destinations for BNSF-originated trains in January 2015 was the Philadelphia Energy Solutions refinery on the east bank of the Schuylkill River in south Philadelphia, the destination for more than two trains per day. It is served by CSX Transportation, with interchange taking place in either Chicago or Smithboro, Ill., on the former Conrail St. Louis Line of CSX and the Beardstown Subdivision of BNSF. In addition to the refineries in Washington state, other frequent destinations were St. James, La. (a distribution hub served by Union Pacific), Linden, N.J. (Phillips 66, reached by Norfolk Southern), and Yorktown, Va. (Plains All-American Pipeline, a distribution hub served by CSX).

The interesting thing is that trains to any destination don't seem to originate at any single loading site. In other words, the logistics companies that run these places appear to be competing to get the business from producers. Trains for Philadelphia Energy Solutions, for instance, were observed late in January 2015 being loaded in Berthold, Dore, Eland, Epping, Fryburg, Manitou, Republic, Tioga, and Trenton in North Dakota and in Tampa, Colo.

This traffic, and the dozens of cars of fracking sand, drilling pipe, and chemicals consumed each time a well is drilled, obviously strains the railroad's capacity. By mid-2015, the Glasgow Subdivision will be double-tracked almost 150 miles, from Minot to west of Williston, N.D. In addition, staging tracks for unit trains were added in both Minot and Glasgow, Mont. The Devils Lake Sub between Minot and Grand Forks, N.D., was on death watch in 2010 as its namesake body of water threatened to swallow the tracks. Then government money to raise the track (Amtrak's *Empire Builder* uses this route) and the appearance of the oil business changed everything. In 2015, both the Devils Lake Sub and the connecting Hillsboro Subdivision between Grand Forks and Fargo, N.D., will get centralized traffic control. Together, these subdivisions will serve as an alternate route to the more-direct KO Subdivision between Fargo and Minot.

In late 2014, the equivalent of 2½ trainloads of oil a day was loaded in Canada, both light sweet crude from the Bakken part of Saskatchewan and bitumen from northern Alberta. **Canadian National** had the foresight in 2006 and 2007 to buy four short lines north of Edmonton that pass through the oil sands region and subsequently invested another quarter of a billion dollars improving its acquisitions. It is the only railroad connecting Alberta to the U.S. Gulf Coast, which surely counts for something. "If you have a single-line haul you'll receive better service, which translates to lower costs," CN's James Cairns says. "Two hands in the cookie jar tends to be more pricey." (Unit trains to the Pacific Ocean ports of Vancouver and Prince Rupert would seem to be a no-brainer, but few, if any, such trains have operated.)

Up to this point, CN has carried oil almost exclusively as cuts of tank cars in its scheduled trains, and between Edmonton and Winnipeg it seems that every manifest train contains strings of these cars.

Of course, all this begs a question: What will CN do if Alberta-Gulf Coast really takes off? Can you imagine a dozen unit oil trains a day heading down the hallowed Main Line of Mid America from Chicago to Louisiana? CN spent $70 million in 2013, above its original intent, to add capacity between Edmonton and Winnipeg, Manitoba, including yard track extensions in Winnipeg and Saskatoon, Sask., extended sidings and sections of double track. The U.S. portion of CN's Oil Highway hasn't gotten such loving care.

Canadian Pacific dispatches about two unit trains a day from its three loading terminals in North Dakota. One is in New Town, at the end of a 111-mile branch line, and a second one nearby at Van Hook. The third is at Stampede, on the Dakota, Missouri Valley & Western Railroad. CP crews bring trains to and from

An eastbound oil train passes through Max, N.D., on Canadian Pacific's New Town Subdivision in November 2011. Steven Welch

CSX moves a train of empties bound for the Bakken field past tank cars in the yard at Elk Mills, Md., on Jan. 25, 2014. Michael S. Murray

Stampede from a junction of the two railroads at Flaxton, N.D., just below the Canadian border. Most of these trains end up at a Global Partners rail-barge terminal in Albany, N.Y., through an all-CP routing, the Stampede trains via Canada and the New Town and Van Hook trains via Chicago, Windsor, Ont., and Montreal.

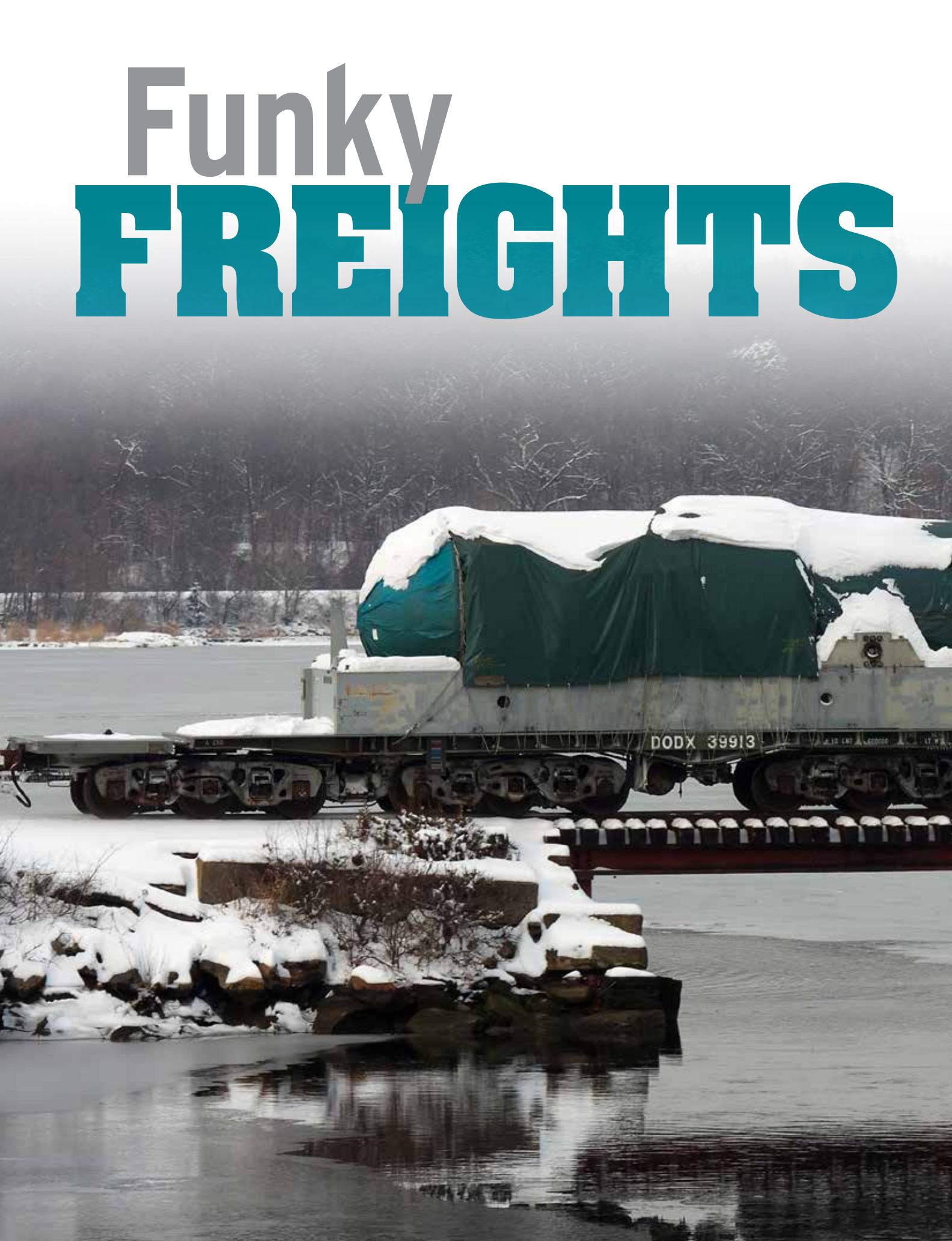
CSX and **Norfolk Southern** play similar roles, competing for primacy at the Delaware River refineries. CSX serves Philadelphia Energy Solutions exclusively and NS the PBF Energy Delaware City, Del., refinery. You'll see these NS trains from Amtrak trains on the Northeast Corridor, inasmuch as they use trackage rights between Perryville, Md., and Newark, Del. Both railroads interchange with BNSF in Chicago, but CSX also gets trains at Smithboro, Ill., and NS at Streator, Ill., on its Kankakee Line and BNSF's Chillicothe Sub. Finally, both railroads bring oil trains to Eddystone Rail Co., a distribution hub on land that once was part of the Baldwin Locomotive Works complex.

Kansas City Southern is potentially an artery for large volumes of oil from Alberta, particularly through its connection in Kansas City, Mo., with Canadian Pacific. So far, the oil has come in cuts of cars rather than unit trains, the gateways being Jackson, Miss., for Canadian National and Kansas City for CP. KCS is partnering with Global Partners on a large oil terminal that will permit barge delivery along the Gulf Coast or export of Canadian oil (by law, U.S. oil cannot be exported). Says Darin Selby, the railroad's energy marketer: "Our goal is more." Who wouldn't approve of that?

Union Pacific's southbound "oil cans" train passes Refugio State Beach near Goleta, Calif., on March 24, 2011. Most of UP's oil traffic is handed off from BNSF. John Roskoski

About two-thirds of **Union Pacific**'s oil revenues come from the trains it gets from BNSF for St. James. That traffic shriveled in early 2015. But Rob Knight, chief financial officer, sees promise in the Niobrara shale formation in Colorado and Wyoming, plus the Eagle Ford and Permian Basin in Texas. "We're in the very early innings of this story," he told an investment conference in 2013. In November 2014 UP and Canadian Pacific began operating crude-oil unit trains between Alberta and Bakersfield, Calif., via Eastport, Idaho, their interchange point on the U.S.-Canadian border. From Bakersfield, oil is piped to the Phillips 66 refinery in Carson, Calif., near Los Angeles. — *Fred W. Frailey*

Funky FREIGHTS



America's railroads make rare and calculated moves of odd loads

The railroad's natural advantage rides in freight trains of consistent, uniform commodities. Mines and factories that turn out the same quantity of product each day enable railroads to oversee their operations with great precision. On these moves, railroads can carefully plan what they'll need in terms of crews, sidings, locomotives, and cars, keeping costs down and ensuring customers a fair rate.

You could call railroads a blunt transportation instrument. When a move calls for high horsepower and large, regular quantities, the railroads are at their most comfortable.

The moves profiled here, though, prove that railroads are capable of a dramatically different type of move. Some shipments travel by rail because roadways won't clear them, or can't handle their weight. Others could travel by highway, but are moving in sufficient quantities and over great enough distances that rail offers a better deal, despite an unwieldy nature that makes them appear, at least superficially, more suited to truck transport.

Even TRAINS readers who make frequent visits trackside may never see flatcars like these. Some cars sit unused for most of the year, emerging from private grounds occasionally to handle a load, then returning to their hibernation. This seems anathema to the railroad environment, where planners insist railcars be quickly unloaded and returned for loading so as to handle enough shipments in a year to amortize themselves. But for moving these loads, there's no alternative. No matter how seldom the cars move, they must be available. These are truly among the coolest rail loads. — *Andy Cummings*

ANDY CUMMINGS, former TRAINS *associate editor, works for Canadian Pacific public affairs.*

SUBMARINE PARTS

Researching Providence & Worcester's "OD extra" is a bit like researching Fight Club: The No. 1 rule appears to be, "You don't talk about the OD extra." However, there are a few things we do know about this train.

The first: The train operates roughly once every 18 months from Worcester, Mass., to Groton, Conn., site of General Dynamics' Electric Boat shipyard, where the company builds nuclear fast attack submarines for the U.S. Navy. In an era when Internet chatter precedes nearly any special move a railroad makes, this one comes without warning. However, its timing usually coincides with deliveries of submarine hull sections, which arrive at Groton by ship.

The train usually consists of two locomotives, an empty "idler" flatcar, a 12-axle loaded flatcar, another idler flatcar, and a manned caboose. All but the locomotives carry DODX reporting marks, indicating ownership by the Department of Defense. A stencil on the side of the tarped load claims it weighs 386,000 pounds.

A source with knowledge of the Navy's nuclear subs tells TRAINS the rail shipment depicted here is likely part of a sub's propulsion system. He says it's not the nuclear reactor vessel itself, but says historically that it, too, arrived by rail and still might.

Providence & Worcester does make deliveries of smaller parts to Electric Boat throughout the year. They move unescorted as part of the railroad's regular trains, though tarps also cover these loads, keeping them out of the public eye. — *Thomas J. Nanos*

THOMAS J. NANOS lives in Lebanon, Conn., with his wife and daughters. He works in the pharmaceutical industry, and photographs the railroads of the area in his free time.

A 12-axle Department of Defense flatcar passes Gales Ferry, Conn., on Jan. 19, 2009. The tarped load is bound for General Dynamics' Electric Boat shipyard, 5 miles south. Thomas J. Nanos

AIRPLANE FUSELAGES

Chances are pretty good that you made your first flight aboard a Boeing 737. As the world's most successful passenger jet, the twin-engined aircraft is flown by hundreds of operators around the world. Of more than 7,700 built since the first 737-100 went into service in 1968, 5,500 remain in service and carry more than 1.5 million people daily.

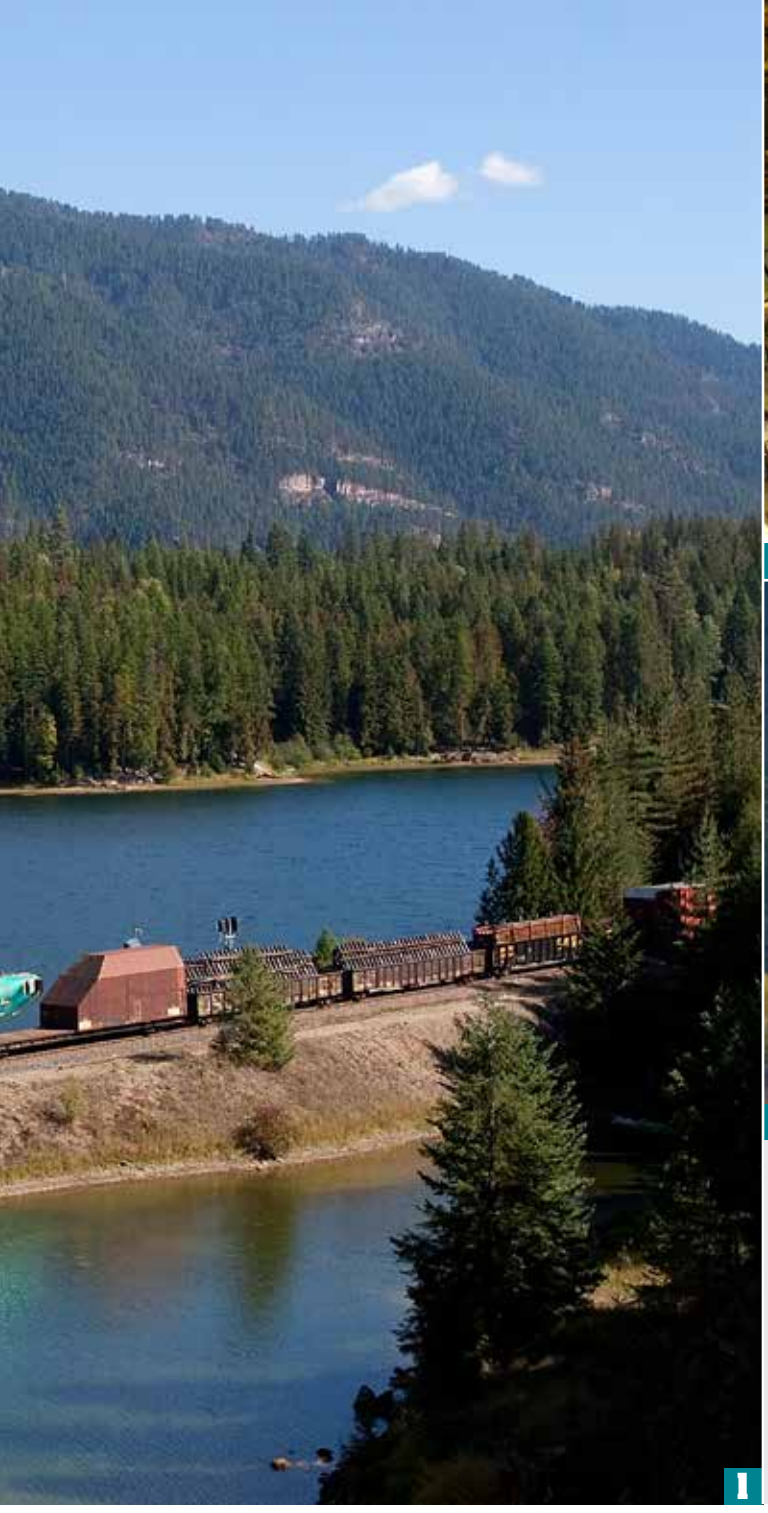
But that 737's first trip? It took place on board a train.

The story starts in Wichita, Kan., where workers at a former Boeing Commercial Airplanes plant (now Spirit AeroSystems) create the fuselage that forms the basis of every 737. Since the wings, engines, and landing gear, as well as avionics, paint, and interiors, are added at Boeing's Renton, Wash., site, the fuselages and other related parts are shipped via BNSF Railway and Montana Rail Link to the Pacific Northwest.

Wrapped in a protective green coating, the aluminum structures may travel singly or in groups of as many as four for much of their 2,200-mile trip. Since Boeing keeps no inventory at Renton, BNSF's timeliness is vital to ensuring that the busy production line stays on schedule, as it produces three different 737 models, not counting military and business versions. Always located behind the motive power and cleared to move on three BNSF routes, the fuselages' progress is closely monitored in daily meetings between the manufacturer and the railroad.

"This is purely a just-in-time operation, down to the hour," says Clinton Watkis, a Seattle-based field sales manager for BNSF. "At any given point in time, we know where the railcars are and at what point Boeing needs them."

Such highly specialized loads require a dedicated fleet of 89-foot flatcars. For carrying



1 On Sept. 26, 2009, a BNSF Kansas City, Kan.-Pasco, Wash., manifest freight ferries fuselages for Boeing 737 airliners across Montana Rail Link west of Noxon, Mont. TRAINS: Tom Danneman
2 Boeing workers lift a 737 fuselage off of a flatcar at the company's Renton, Wash., plant on March 27, 2007. Mike Harbour
3 Occasionally, BNSF will dispatch a "Boeing Special" to deliver high-priority fuselages to Renton. One such special passes through Clinton, Mont. TRAINS: Tom Danneman

the fuselages themselves, which range from almost 100 feet to more than 130 feet in length, a group of flats have been modified with jigs to connect the deck with the belly. There's also a vertical frame attached to the leading end of each fuselage flat to protect the nose from damage in transit. Proper spacing is achieved with either plain idler flats or idler-canopy flats equipped with room to carry additional lading.

On BNSF, the fuselages are the only high-wide loads precleared on the railroad, because their dimensions don't change from move to move. For flexibility, they may run in scheduled (Boeing service only) trains, in high-priority merchandise trains, or in intermodal trains, Watkis says, depending on the manufacturer's production schedule. Transit time is usually seven to eight days, according to Boeing, but can take as little as four days.

"Regardless of whatever service level they need based on the production at either origin or destination, we can deliver to that schedule," Watkis says. "Obviously, if they need less than four days, we have an issue."

With the continuing popularity of the 737, Boeing has recently boosted production to 42 aircraft each month; by 2018, that number will increase to 52. The reason: As of August 2013, the 737 had racked up more than 13,000 orders since production began more than 45 years ago. Those green fuselages will remain a part of the Western railroad landscape for years to come. — *Mike Harbour*

MIKE HARBOUR is a freelance writer, based in Fort Worth, Texas.

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WINDMILL PARTS

On an April 2011 night, at an old junction site north of Janesville, Wis., Wisconsin & Southern Railroad Trainmaster Don Pingel eyed the move in front of him carefully. It was his railroad's first unit train of Vestas windmill blades, on their way from a plant in Colorado to a wind farm taking shape among the dairy farms near Cambria, Wis. As the 144-foot-long blades began negotiating the junction's curve, their tips swung wide.

Pingel began to worry. Some 50 miles ahead, the blades would need to navigate Wisconsin & Southern's junction with Canadian National in Waukesha without spearing crossing gates, utility poles, interlocking signals, or other obstacles. The engineering department had crunched the numbers, and the movement worked on paper, but the swing-out was extreme.

"I'm standing 6 feet off the ends of the ties, and the tip of the blade is over my head," Pingel recalls. "I kinda hit the panic button."

The next day, on CN rails at the Grand Avenue interlocking, railroad officials watched nervously. As the first blade eased into the curve, it swung wide, but quickly returned to the track gauge as the modified flatcars rounded the curve.

"I shouldn't have second-guessed the engineers," Pingel says. "Everything they said was going to happen, happened."

Perhaps the toughest part of a windmill move is its temporary nature. Wisconsin & Southern handled 10 trains of blades, nacelles, and hub assemblies from April to July 2011 at a rate of roughly one per week. Vestas had worked with the railroad and a farmer who owns land adjacent to the line to set up an unloading site. There was no siding, so as Vestas unloaded its freight, other trains couldn't reach shippers at Cambria. An extra crew was on hand to spot the train's cars near a crane for unloading.

"We had to have crews at the unloading site day after day," Pingel says. "Some days, they couldn't use cranes because of wind or lightning, but we had a crew on duty in case the weather let up. We had a three-to-four-day stretch where little unloading was occurring, but we still had to have a crew on site."

Another wrinkle in the unloading process was the need to retrieve the blades in a particular order. Each fiberglass blade was built for a specific tower. The contractor handling the unloading often asked the train crew to spot a particular car beside the crane as a tower was ready to receive it. At other times, the company simply unloaded blades in order and placed them in a staging area.

Longer delays could have caused problems. Empty trainsets needed to return to Colorado so Vestas could reload them for the next trip. At one point, it appeared Wisconsin & Southern might get stuck with two loaded trains on its railroad simultaneously. For a railroad composed of secondary lines, where meets between long trains rarely occur, this was unacceptable. Fortunately, unloading resumed quickly, and the railroad returned an empty train to the Union Pacific interchange at Janesville as the next arrived.

Wisconsin & Southern used caution moving costly windmill parts. Siemens Energy filed suit against BNSF Railway in 2011 after blades traveling by train allegedly struck an overhead bridge at Kansas City, Kan. The company valued the 21 damaged blades at $2.6 million.

"There's extra liability here, too," Pingel says. "It's not just free money. That's why everybody here is very cautious. They realize what's at stake." — *Andy Cummings*

1 Two SD40-2s lead a train of blades near Palmyra, Wis. 2 A blade negotiates Grand Avenue interlocking at Waukesha, Wis. Once through the curve, it'll enter CN rails, which Wisconsin & Southern uses under a trackage rights agreement. 3 Workers have tied an I-beam connected to a crane onto the brackets, and are preparing to lower the load onto a semi trailer. Three photos, Andy Cummings

HARRIET, THE GAS TURBINE

In South Carolina, several unusual high-wide loads come through on both of the state's Class I rail lines. Most of these are large gas turbines from the General Electric plant in Greenville to points overseas.

In most cases, the first leg of the journey for a gas turbine is on short line Carolina Piedmont Railroad, a Genessee & Wyoming property. It travels from Greenville to Laurens. Loads like this one typically run on Saturday in order to avoid interfering with normal weekday freight railroad operations. CSX Transportation picks up the train with its own power on Sunday for the trip down the former Columbia, Newberry & Laurens Railroad to its Cayce yard. CSX then continues the trip on Monday to the Port of Charleston.

But in April 2014, one high-wide load made the reverse move. The official name for the turbine the railroad carried on this trip is the 9HA, but General Electric calls her "HArriet — "H" for "high efficiency" and "A" for "air-cooled." She's a behemoth, an 866,000-pound, high-efficiency gas turbine, the largest of her kind in the world. Built in France, she came across the Atlantic on a ship and then transferred to rail.

I caught the move you see here at Irmo, S.C., outside the capital city, Columbia. The train stopped just before the Highway 76 bridge, where a low clearance meant that crews had to work to ease the train under the two-lane road. The pedestrian access on the bridge allowed for a bird's-eye view of the crew from Emmert International, which specializes in transport of heavy and oversize cargo, as they maneuvered HArriet.

The next day, the machine moved from Laurens to Greenville. Unfortunately, the train encountered rain, which caused additional hardship on the crews to make sure the move was safe.

The weather did not stop folks living nearby from coming out to see the big load pass through. Local TV and newspapers had been talking about it for days. GE had even given HArriet her own social media page and tweeted out progress reports of her trip.

Railfans were out, too, of course. But at least one person was not so impressed. At a local gas station along the way, a man came in talking about all of the people beside the train tracks. The cashier grabbed her smartphone and went to the door, saying she was going to take a picture. As the train came into view, her shoulders slumped. "That's all?" she asked.

The careful planning it takes to make a move like this happen is incredible. And the fact that CSX and Carolina Piedmont coordinate it several times a year is mind-boggling. As police cars and crowds dissipated once HArriet made her way through several little towns, she reached her destination. She received a deserved welcome at the GE plant, where local television crews were waiting to film her arrival.

Since then, HArriet has been undergoing testing. GE had to build a new turntable to get her situated inside and erect a gas plant to keep her filled. Crews are designing four new versions of HArriet, which will ship to Texas in 2016 for Exelon, one of the largest power generators in the United States. — *Joseph Hinson*

JOSEPH HINSON is a photographer and freelance writer, living in Columbia, S.C.


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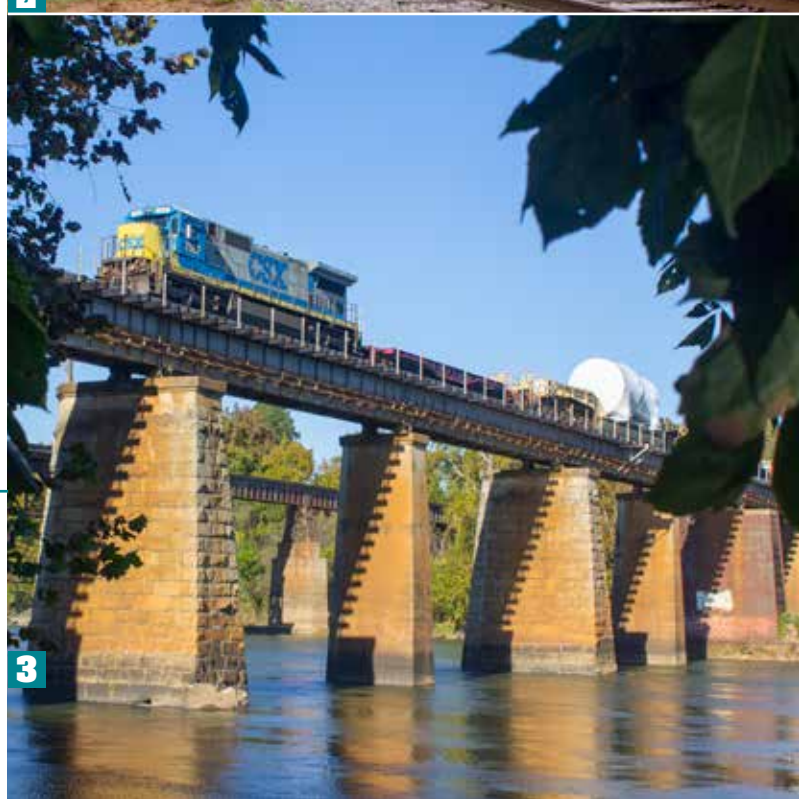

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1 The GE HArriet, a high-efficiency turbine, makes the first leg of its journey over Genesee & Wyoming's Carolina Piedmont at Laurens, S.C., on April 19, 2014. 2 From the caboose of the train, here's HArriet at Owings, S.C., heading to the GE plant in Greenville, S.C. 3 Not HArriet, but a typical GE high-wide load crosses the Congaree River from Columbia to Cayce, S.C. Three photos, Joseph Hinson

1 A Norfolk Southern train carrying Tindall Corrections prefab jail cell modules pulls into Kinston, N.C., on Sept. 21, 2011. These shipments moved as part of NS's regular trains through Kinston that originate at Selma, N.C. The trains delivered a total of four cuts of cells to Kinston. In all, the railroad delivered 100 modules. Each module houses two jail cells. Ward C. Sutton **2 "Anzio Annie," a product of Germany's Krupp Steel, rides an eight-axle flatcar at Norfolk Southern's Enola, Pa., yard on Jan. 4, 2011. The car on which it was designed to ride is a 12-axle gondola, with six axles in front and another six in the rear. Krupp didn't design the gun to pivot on its perch, so the German Army used curves in the track to align the barrel with its target, then adjusted its trajectory to set the range. The gun was capable of firing shells at targets 38 miles away. In late January 2011, the U.S. Army reunited the gun with its gondola at the museum's new site at Fort Lee, Va.** James Kerr **3 A Nigeria-bound Air Products heat exchanger rests atop a pair of 12-axle depressed-center flatcars at Packerton Yard in Lehighton, Pa., where Reading & Northern and Norfolk Southern interchange.** Aaron Stilson

JAIL CELLS

Lenoir County, N.C., was facing a problem familiar to local governments across the country: too many prisoners and not enough housing. Lenoir began paying other counties to house its inmates, an expensive proposition for taxpayers. Then Norfolk Southern Railway, the railroad serving the county seat in Kinston, N.C., played a role in solving the problem.

For the new prison, the Corrections Division of Tindall Corp. manufactured prefabricated concrete modules that each house a pair of 85-square-foot jail cells. At its San Antonio plant, Tindall installs the plumbing, toilets, electricity, and lights. At the prison site, the modules are designed to stack on top of each other "like a giant Lego set," Assistant County Manager Tommy Hollowell told the Kinston Free Press.

'ANZIO ANNIE'

In 2011, the U.S. Army Ordnance Museum relocated from the Aberdeen Proving Ground in Maryland to Fort Lee, Va. One piece of the collection had to be moved by rail due to its weight: the 11-inch-diameter barrel of "Anzio Annie," a railway gun that terrorized Allied troops invading Italy in 1944.

After World War I, Germany's Krupp Steel built the guns and the 12-axle gondolas they rode on. Railway guns were considered obsolete by World War II, as planes could easily destroy them, but the Italian railways had the perfect companion for the Krupp guns: a tunnel east of Ciampino, Italy.

The German Army hid two Krupp railway guns in the tunnel for nearly three months while Allied troops tried to break out from their beachhead at Anzio, 19 miles to the south.

Diesel locomotives would move the guns out of the tunnel, one at a time, and one would fire six to eight shells, then retreat. The guns bombarded beach targets, and even hit ships in the harbor, sinking one. They also proved effective in destroying Allied supply depots. As impossible as it seemed, these aging, outdated guns kept Allied forces at bay.

The guns' targets, not realizing they were actually victims of two guns, referred to their tormentors as "Anzio Annie." After nearly three months, the Allies forced the German Army to retreat and seized the guns. Using pieces from both guns, the U.S. Army assembled its version of Annie at Aberdeen. Early last year, it came time to move this piece of military history.

The gondola moved by truck, but the Army hired Norfolk Southern to move the 110-ton gun barrel.

HEAT EXCHANGERS

Air Products and Chemicals Inc. assembles some of the longest loads shipped by rail at its Wilkes-Barre, Pa., plant: colossal cryogenic heat exchangers for use in liquefying natural gas, bound for export. The biggest exchangers require twin 12-axle flatcars, and about two go by rail each year.

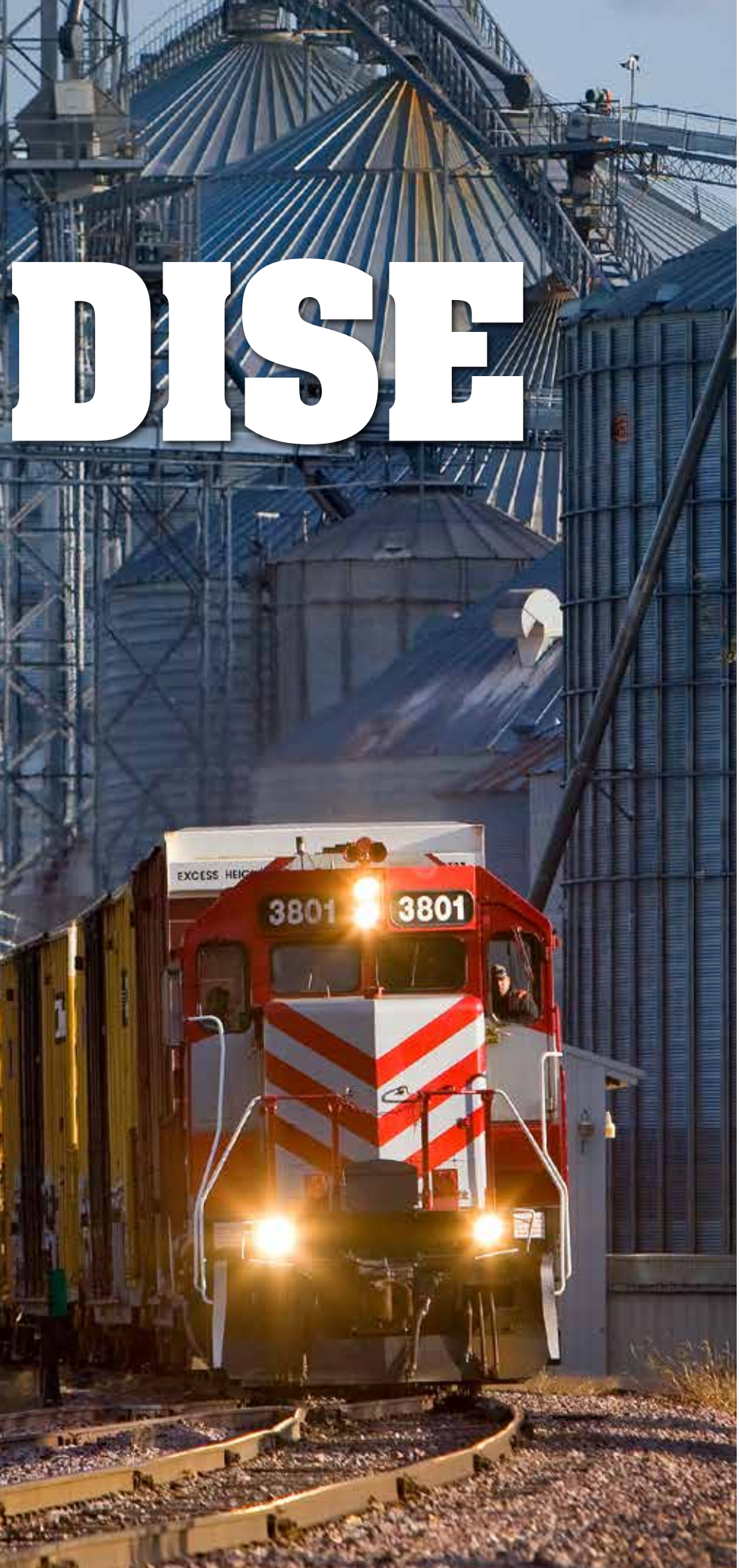
Exchangers either travel to the company's manufacturing annex facility on the Delaware River near Morrisville, Pa., or directly to Port Newark, N.J. To get to Morrisville, dedicated trains use a Luzerne & Susquehanna-Canadian Pacific-Reading & Northern-Norfolk Southern routing via Lehighton and Reading, Pa. When traveling to Newark, they travel most of the same route, but pass to CSX at Manville, N.J., for forwarding to Newark's Oak Island Yard.

— *Andy Cummings*

4 On Jan. 25, 2015, Norfolk Southern takes its second load on Schnabel car WECX No. 800 through Columbia, S.C., en route to the V.C. Summer Nuclear Station, outside Jenkinsville, where a third reactor is being built. Joseph Hinson **5 A unit train of General Electric export diesels heads east on Norfolk Southern's Blue Ridge District, east of Appomattox, Va., on Feb. 28, 2013. The white engines are 42-inch gauge CM20-EMPs, which will be used in passenger and freight service on Indonesia's island of Java. To the rear are green 5-foot 3-inch gauge ES58ACi locomotives, headed to Companhia Vale do Rio Doce mining company in Brazil. This train is headed to the port of Norfolk, Va., where the diesels will be loaded onto a ship for the long voyage to Brazil. These engines will transport iron ore from the Amazon region to Sao Luis port. The trucks for both of these types of locomotives are transported on separate flatcars.** Alex Mayes **6 A northbound Alaska Railroad freight glides along Turnagain Arm near McHugh Creek on the main line, en route to Anchorage, on Sept. 18, 2013. On the head end of the 88-car train are 36 flatcars, loaded with large-diameter steel pipe, destined for the oil fields to the north.** Alex Mayes

LOCAL FREIGHT

Moving the MERCHAN



The changing world of carload freight

by Michael W. Blaszak

As the end-of-train device on the intermodal flyer fades into the dust, the crew of the local freight train springs into action. On authority received from the dispatcher, the brakeman aligns the siding switch and a lone locomotive urges its short consist of covered hoppers, tank cars, and center-beam flatcars forward onto the main line. For the next two hours this lowly train is king of the road, flitting between the main track and a tangle of connecting spurs to distribute its cars of raw materials to factories and warehouses that supply the necessities and luxuries of life to people in the area and around the world.

In today's heavy-duty railroad universe, the local train's work is as unglamorous as it is necessary and lucrative. While stock analysts and railroad managers lavish attention on the industry's growth markets — intermodal and crude oil — the rest of railroading seems to operate in a figurative shadow. This seems especially true for industrial products that move in less-than-trainload quantities: the single-car movements that characterized the freight business from railroading's creation well into the 1980s. Yet this traffic is vital to North America's railroads, and the carriers not only remain dedicated to moving it, but are encouraging it to grow profitably.

WHERE CARLOAD FREIGHT FITS IN

The perception that North America's manufacturing base is collapsing as production shifts to lower-wage countries is widespread, but not entirely accurate. According to the Department of Commerce, manufacturing accounted for about 12 percent of U.S. economic output in 2013, down from 27 percent in 1950. While that's a substantial decline, this trend is not recent. Manufacturing's share of economic activity dropped steadily for a half-century before stabilizing near the current figure, as service industries like computer software mushroomed and industrial production chased lower wages to Europe, Japan, the

Wisconsin & Southern local L463 passes grain elevators as it returns to the yard at Rock Springs, Wis., at the end of its turn to Madison on Oct. 14, 2011. John Ryan

A short Canadian Pacific local heads west out of Exshaw, Alberta, on CP's Laggan Subdivision along the Bow River. TRAINS: Drew Halverson

four Asian "tigers" (South Korea, Taiwan, Hong Kong, and Singapore) and today's growth economies of China and India.

The decline has been propelled by a one-two punch of cheaper overseas labor and falling transportation rates. The disparity in labor costs is especially startling. In 2013, according to The Conference Board, a business association, the average hourly cost of a manufacturing worker in the U.S. was $36.92, compared to $3.07 in China. Meanwhile, trans-Pacific freight rates declined as the 20th century closed, making U.S. distribution of products made in low-cost Asian factories cheaper. After a period of stability, these ocean rates nosedived in early 2015, which will only fuel the voracious growth of Asian manufacturing. For example, about 90 percent of audio and video equipment, and of shoes, sold in the United States are made abroad, primarily in Asia. America's dependence on Asian imports was highlighted in March 2015, when resolution of the labor dispute at West Coast ports caused the trade deficit to zoom 43 percent to $51.4 billion.

Not all North American industries can economically relocate overseas, however. Some, like chemicals and plastics, have substantial investments in domestic facilities with relatively low labor inputs. Others, like construction, by definition must take place here. And for still others, like food products, the combination of resource and labor availability, distribution costs, and perception of customer safety tips the scales in favor of domestic production, despite higher labor expenses. These types of industries are the primary markets for railroading's carload freight services.

It's not easy to determine where carload freight fits into railroading's big picture, as opposed to unit-train and multiple-car shipments. Statistics don't exist. Individual railroads report their traffic by commodity type (e.g., grain, metals, coal) but do not record the line-haul train service by which each revenue unit was handled. Even a commodity like coal can move in 115-car unit trains to a giant electric utility or in small groups of cars bound for a university heating plant.

The Association of American Railroads breaks the industry's freight traffic into 18 categories (and "other"). In 2014, railroads transported a total of 15,176,835 carloads (excluding intermodal). Taking away grain, coal, coke, crushed stone, sand, and gravel, — all of which frequently move in unit trains and multiple-car blocks — leaves 6,916,352 units as a rough measure of traffic that typically moves as single or small numbers of carloads, or about 46 percent of the total. In 2000, by contrast, the railroads moved 8,367,158 units of this traffic, or 48 percent of the total.

So carload traffic isn't on a trend-line to extinction. Railroads are focused on profitability, not raw volume, and most of the remaining carload business meets the carriers' profit-margin requirements. Railroads consider conventional carload traffic an integral part of their future business. BNSF Railway, for one, generated $6.2 billion in industrial-products revenue for 2014 on shipments of chemicals, plastics, petroleum, construction products, and building products. That's more than either BNSF's coal or agricultural products businesses brought in.

THE EVOLVING TRAFFIC BASE

The North American economy is dynamic, and companies are continually making changes in their processes to im-

Vermont Rail System conductor Gene Lamoureux lines a switch at White River Junction on Jan. 14, 2013. Kevin Burkholder

prove profitability. Railroads are forced to follow these industrial and distribution trends, resulting in substantial turnover in the carload segments. Once-reliable traffic has vanished, although much of it has been replaced with business from new sources.

Steel is one segment of the carload market that reflects this pattern of change. The domestic steel industry endured a secular decline for decades, symbolized by the idled Bethlehem Steel blast furnaces that Norfolk Southern trains roll past in Bethlehem, Pa., on the former Lehigh Valley Railroad. The output from idled mills, though, has been replaced by slabs of imported steel moving from ports to finishing plants. At the same time, mini-mills producing steel from scrap iron heated in electric-arc furnaces have decentralized the steelmaking process. Mini-mills generate both inbound (scrap) and outbound (steel products) rail traffic, and have located primarily near smaller cities in the Midwest and South.

Waste materials have gained prominence in the carload mix. In addition to municipal solid waste handled both in unit trains and individual carloads, railroads are hauling sludge from wastewater treatment plants to landfills, and recycled paper back to paper mills. Another growing commodity is construction and demolition debris shipped out of city centers in hopper cars and gondolas.

Loads of grain-mill and food products like flour, edible oils, and sweeteners keep generating revenue dollars for railroad coffers. Chemicals, by far the most significant carload traffic segment, have held their own, growing in both volume and revenue per car since 2006. On the other hand, forest products such as logs and pulpwood, processed wood pulp, and paper make up a declining slice of the traffic pie. On Canadian Pacific, forest-products carloads declined 57 percent from 2006 to 2014. CSX Transportation also reports that its canned-goods business dropped in 2014.

Along with an evolving traffic mix, the origins and destinations of traffic shifted south and west with the migratory flow of the population. From 2000 to 2014, the population of the United States rose 14.6 percent, with the increase concentrated in states like Nevada, Arizona, Florida, and Texas. Since all those people need food, clothing, shelter, and transportation, rail traffic to cities like Las Vegas increased, while traffic growth has been more difficult to achieve in the de-industrializing and demographically stagnant states of the Northeast.

With two Geeps for power, a Norfolk Southern local switches a flour and corn syrup transloading facility near Simpson Yard in Jacksonville, Fla., in January 2014. Henry Dell

On May 17, 2013, Montana Rail Link's 844 local proceeds up the 6th Subdivision Branch to serve a grain and fertilizer customer at the line's end in Harrison, Mont. TRAINS: Tom Danneman

THE NEED FOR SPEED

The mantra repeated by managers throughout the railroad industry is: Operate more efficiently by moving shipments and empty cars faster. BNSF has been particularly vocal about the need to move cars more rapidly. In 2006 the railroad took the unusual step of telling shippers that it was changing its management pay program so that "a significant portion of our compensation will be tied to improvements in velocity."

Assembling carload traffic into unit trains or multiple-car blocks is one common way railroads have increased velocity and throughput. When cars move in large groups they are cheaper and easier to manage, and the chances for switching mistakes and missed train connections are reduced. "Simpler is better," NS Vice President-Strategic Planning Dan Mazur said in 2006, "and usually cheaper." BNSF Group Vice President-Industrial Products Dave Garin agreed, saying, "I want to run the biggest, most efficient trains that provide the best service."

Often that means aggregating traffic

into unit trains. Grain shipments, once loaded predominantly at small country elevators a few cars at a time, were herded into unit or "shuttle" trains in the 1990s and 2000s by railroad service and pricing incentives. More recently, railroads originating frac-sand shipments, like Union Pacific and Canadian National, built unit-train networks that largely supplanted single- and multiple-car sand movements as demand mushroomed with the shale-oil-drilling boom.

Aggregates are another commodity well-suited to unit trains. In 2005, UP revamped its rate and service offerings for crushed-rock traffic in Texas and surrounding states with what it called the "Rocktimization" program. Customers were offered "the best shipping value for the largest and shortest cycling trains." Within a year, UP had improved car cycle time by 7 percent. Even traffic handled in boxcars can be unitized. In 2006, Railex LLC debuted a weekly 55-car train of refrigerated boxcars between cold storage warehouses in Wallula, Wash., and Rotterdam, N.Y., over UP and CSX, carrying apples, pears, potatoes, and onions east. Since then, Railex has attracted wine, frozen food, and dairy shipments, and opened new warehouses in Delano, Calif.,

CONNECTING THE NATION

The humble local is the underpinning of a much larger idea

A local serving citrus-packing plants on Southern Pacific's Santa Paula branch rolls through Piru, Calif., in 1983. Bruce Veary

Ask railroaders of different generations if they are familiar with "local freight," and you are likely to get "yes" tinged with sarcasm. Everyone knows local freight.

Ask those same railroaders to describe "local freight," and there may be three sets of opinions.

Anyone who went railroading within the past decade will have a neat, clean, and reasonably rational definition, based on the brave new world in which we live.

Anyone on the railroad before 1970 or so will likely describe an operating environment that has much in common with the old Railroad Man's Magazine.

The railroaders who came up in the last quarter of the 20th century may be at a loss. They may still be trying to figure out what local freight is and how to make it work.

It isn't much of an exaggeration to suggest that "local freight" is like truth, beauty, or art. People may agree on its general characteristics, but reducing it to a reliable definition is something of a fool's errand.

The significance of "local freight" lies not so much in what it is, but in the ideas behind it. The principle that any customer on any railroad had access to every other customer was nothing short of revolutionary. It all depended on the oft-ignored, seriously disrespected local.

LOCAL HISTORY

For the "traditional era" — the 1880s to 1980s — the most effective way to grasp "local freight" is to understand what it was not.

It was not the over-the-road, hotshot, or scheduled service that a wise trainmaster handed off to the next division as quickly as possible. It was not the trainloads of coal, ore, grain, or commodities that so often represented the greatest tonnage and the least net profit. Local freight wasn't the drag, the extra, or the trailer train.

Traditional "local freight" was about personal relationships, not arbitrary distinctions; it was the most common and important contact between railroads and customers. Local freight is about the "hand-off," and all that entails.

Single-car railroading and local freight was the manifestation of a distinctively American way of understanding the world. By the early 20th century, the presumption was simple and almost universal: Any business on or near a railroad had access to any point elsewhere on the network, at a predictable and proportional rate.

It is difficult to overstate how banal and revolutionary this principle really was. On one hand, it meant that ordinary business could proceed on a rational and orderly basis. The uncertainty and risk of

and Jacksonville, Fla.

Railroads will continue converting more movements to unit trains, but single-car shipments are not going to vanish. "As much as we want to take the complexity out," Garin said, "we can't." In 2006, BNSF served about 5,000 customer locations, each one of which shipped to a myriad of points. One steel shipper, for example, regularly released cars to a thousand destinations across the continent from just a couple of origins. To deliver and pull cars to and from its customers, BNSF started between 600 and 700 local freight trains a day.

After years of analyzing mainline traffic flows, the railroads have developed a high degree of regularity in their terminal-to-terminal operations. The game books have different names — Precision Railroading on CN, Thoroughbred Operating Plan on NS, One Plan on CSX, Unified Plan on UP — but the goals are the same: Meet customer requirements with the most efficient use of labor, equipment, and track capacity.

When a car is released by a shipper, the originating railroad's computer develops a trip plan, assigning the car to be switched, blocked, and handled through specified yards and road trains. Freight trains have schedules, and the yards are tasked with

A Santa Fe local awaits action at the Cañon City, Colo., depot in May 1967. Steve Patterson

transportation had been mostly wrung from the system.

On the other, it meant railroads were bound to provide the kind of universal access we now take for granted — albeit in a harshly regulated environment, with the legal presumption that railroads were guilty until proven innocent.

Old-time front-line officials probably had the most realistic view of traditional railroading. They knew that single-car freight was their bread and butter. The goal was to move as much tonnage as possible over the longest distances, and let either end take care of itself. Locals were the "either end."

That experience led to an unfortunate, but often inevitable, conclusion: Local freight was a royal pain in the neck. Few operating officers enjoyed crafting a mutually acceptable solution from three different points of view. The company argued once-a-week service was plenty. The customer wanted a locomotive and crew standing by 24/7. And a union local chairman saw jobs, overtime, and a chance to sleep in one's own bed.

Train dispatchers rarely enjoyed the challenge of threading a generally unpredictable local run between and among whatever other traffic they had out on the railroad. Efficient mainline railroading is all about forward motion and orderly procession. Local freight is the opposite. It is stop-and-start, sort-and-switch, and guaranteed to complicate even the most straightforward dispatcher's lineup.

LOCAL CUSTOMERS

For hundreds of thousands of large and small customers over the better part of a century, local freight service was the physical connection to the outside world.

Two issues lay at the heart of the contentious relationship between railroads and their customers: rates and quality of service. Frank Norris captured this tension vividly in his early 20th century novel "The Octopus." The book's Pacific & Southwestern, based on mightly Southern Pacific, used local freight service like a cudgel to subdue and extort. It would provide, withhold, or "augment" service as it saw fit.

There was, of course, a flip side. In the late 19th and early 20th centuries, railroad customers formed chambers of commerce, traffic leagues, manufacturer's associations, and grange organizations. The unifying goal was better, or at least more equitable, railroad service. And of course, they wanted lower freight rates.

For nearly 30 years, railroads and customers fought in courts, Congress, and the media. As powerful as the railroad industry was, its customers represented an equally potent political force, and by 1910 the sides wrestled to a draw. The conflict hardened into a scheme that encouraged single-car handling and discouraged innovation.

For the next 70 years, the conduct of single-car railroading in the United States was shaped not by market forces, technology, or even rational public policy. It was left to an agency of the federal government. The Interstate Commerce Commission was the local customers' court of first resort, and they availed themselves freely.

LOCAL IDEALS

There is another way to look at local freight. I think it stands in nicely for what railroading was all about and how it shaped the American character.

As the railroad network grew more dense, we began to regard the mobility it offered as something of an inherent right. We came to understand the railroad as a shared resource to be managed in ways that respected American ideals and values. That, of course, was often contrary to the views held by railroad owners and financiers.

Traditional single-car railroading is an artifact of that tension. For most of the 19th century, the idea that any business, farm, or customer on the national railroad network would have universal, unrestricted access to any other point on the network would have been absurd. To think that the federal government would supervise such a system and enforce fairness and performance would have been beyond most people's imaginations.

By making the costs of transportation reasonably predictable, the ICC — for all of its flaws — made it possible for American industry to plan and invest on an entirely different basis.

The deceptively simple idea that anyone could ship anything to anywhere in the country by rail had profound and far-reaching effects. And it relied on an equally simple idea: the promise that every car would reach its destination.

— John P. Hankey, a frequent TRAINS contributor

A trio of warbonnet units lead a BNSF local out of Needles, Calif., toward a crew change in Kingman, Ariz., in May 2011. Kyle Ori

making sure connections between those trains are made. Barring complications like weather problems, derailments, or congestion, the car is moved to the destination yard in accordance with the plan. As a result of this improved operating discipline, carload freight service "is much more predictable and reliable than at any time during my career," retired Indiana Rail Road President Tom Hoback observed.

Canadian National schedules every support process leading up to a car movement, including time on service tracks, car inspections, and maintenance-of-way windows. Within terminals, CN manages carload switching with its SmartYard computer information system, which debuted as a pilot project in 2005 at CN's largest and busiest yard, MacMillan Yard near Toronto. SmartYard models the optimal sequence for cars on the yard tracks, continually adjusting to operating variables. CN credited SmartYard with reducing the average time a train stays in MacMillan Yard by six hours, and expanded the system to other classification yards.

The challenge facing railroads is to improve the reliability of their gathering and distribution operations to match the timeliness of their through trains. "The biggest problem we need to work on," BNSF's Garin said, "is the first and last mile" of any movement. CSX is attacking the problem by implementing its Total Service Integration plan, which already governs its intermodal and unit trains, for what it calls "batch" train service, moving manifest carloads between major yards. This requires developing detailed schedules for freight trains and locals, making sure connections are made, and running to plan even when traffic is light. Local-train work events are loaded in an Industrial Switching Excellence computer tool to measure compliance with the plan. One goal is to place the right number of empty cars for loading when the shipper wants them, rather than delivering too many one day and setting out none the next.

CN is implementing a suite of initiatives called Customer FIRST to attack first mile/last mile variations through improved communications. Shippers can establish an eBusiness account, giving them secure access to the railroad's car movement plans and a delivery date guarantee. Through the iAdvise link, operating department employees send Local Service Notifications to customers, advising them of the local's daily work plan and any circumstances that would cause a delivery date to be missed.

TRANSLOAD VS. DOOR-TO-DOOR

One issue that railroads have grappled with for nearly two decades is the relocation of factories and warehouses away from established rail lines into industrial parks designed to facilitate truck transportation. To provide carload service to customers at these locations, railroads have relied on transload (sometimes called reload) centers. A transload resembles the railroad freight house of old. The railroad switches cars into the facility, where they are unloaded and their contents stored and then distributed by truck. Usually the transload

A CSX local passes through Waverly, W.Va., during its run on the Ohio River Subdivision on Nov. 14, 2009. Todd Atkinson

is operated by a third party independent of, but with close commercial ties to, the serving railroad. The operator often provides additional services such as warehousing, trucking, and supply-chain management. As might be expected, traffic through transload facilities is "outpacing conventional carload delivery," Garin said.

Another strategy to improve switching efficiency is to entice customers to locate new facilities closer to yards where local trains originate. BNSF is doing this by developing "logistics parks" outside major cities, in areas where land cost is low enough to economically accommodate large warehouses and factories, as well as a rail yard. The pattern was set in Alliance, Texas, in the mid-1990s. BNSF opened Logistics Park Chicago in 2002 (on land reclaimed from a onetime Army ammunition plant), followed by Logistics Park Kansas City in Edgerton, Kan., which opened in 2013.

Other railroads have followed BNSF's lead. CSX opened a integrated logistics center at Winter Haven, Fla., capable of growing to include 7.9 million square feet of warehouse space and light industrial buildings, and added an intermodal facility in 2014. UP serves the East Kelly Railport, a site with warehousing, cold storage, and transload facilities, east of San Antonio, Texas. That facility has grown to 350 acres since it opened in 2008, and it's also served by BNSF. Norfolk Southern's first logistics park development is the Rickenbacker Intermodal Terminal near Columbus, Ohio. While Rickenbacker is devoted primarily to container movements between Chicago and the Port of Norfolk, Va., the railroad expects the yard eventually will have a carload component. And Canadian National has five logistics parks, most recently adding facilities in Calgary and Chicago.

Will there come a point when the drive to improve efficiency will lead to disconnecting carload shippers with low volumes or in difficult-to-access locations? Railroads are understandably reluctant to discuss sticks instead of carrots, but their actions reflect the carriers' preference to do business with customers that are easy to switch and generate enough traffic to justify the expense of leaving the switch in place.

CSX stated in mid-2006 that it would evaluate requests for new industry tracks on a case-by-case basis with an eye toward minimizing switching on mainline tracks. The railroad faced a dilemma (shared by other carriers) in that its primary growth opportunities are on north-south lines that are predominantly single track. CSX preferred to see new rail-served facilities located in industrial parks where switching can take place off the main line, or have the industry build enough lead track so that locals aren't getting in the way of through trains.

Having tied down eight cars on the main, Union Pacific's Sheboygan, Wis., local, YSB52, heads to pick up empties at Alliant Energy's fly ash facility on July 27, 2013. Rich Peters

Looking much like a model railroad, Canadian National local L56591-11 works a lumber yard in Delaware, Iowa, on the Dubuque Subdivision in September 2014. Craig Williams

Union Pacific announced a sweeping review of its industry tracks on Aug. 1, 2006, and said it planned to enforce compliance with its policy of not switching a customer unless it has an industry track agreement in place. (The agreement apportions the cost and liability associated with a railroad's operation on spur trackage owned by a shipper.) The railroad found that many shippers had no agreement at all, while others were still operating under decades-old contracts that did not reflect current market conditions. Spokesman Mark Davis said track connections and agreements would be evaluated "to make sure they're in line with our business strategy," and if no agreement is in place "there will be [service] disruptions."

CARLOAD BUSINESS IS HERE TO STAY

Railroads like to talk about the growing segments of their business, since expectations about future earnings are what move their stock prices up. Coal and intermodal traffic have long been strengths, and oil traffic has provided a recent boost.

But in the background, the humble local freight train will keep distributing the other commodities that are demanded by our contemporary economy, from roofing granules to plastic pellets to aluminum ingots to wallboard. Expect railroads to continue finding ways to handle their conventional carload traffic more reliably and efficiently, meeting customer requirements while contributing to the bottom line. T

Union Pacific rock train RVUVU-18 curves past the Ravenna control point in Soledad Canyon on Feb. 18, 2012. Trains move from the Vulcan Material Co. quarry, 12 miles south of Palmdale, Calif., to Sun Valley, Calif., over UP's Mojave Subdivision and Metrolink's Valley Subdivision. David Styffe

ROCK

Rolling STONES

How Class I railroads make money hauling rocks, sand, and stone

by Tom Murray

During the past decade, rail executives' conference calls with Wall Street analysts have often included talk of *reinvestable* business. Traffic that railroads consider reinvestable typically includes long-haul, high-value freight such as intermodal containers, crude oil, and chemicals. Revenue from this traffic covers its current costs and generates an economic return that supports future rail system renewal.

At first glance, construction aggregates — stone, sand, and gravel — seem to fall far short of these standards. They're low-value commodities and they tend to move only short distances by railroad.

But even though their revenue per car is low, they are nearly perfect freight: indestructible and relatively harmless if spilled. In fact, the Class I railroads have been able to make this freight reinvestable. Rate increases have been part of the formula, but the biggest factor has been a relentless focus on cost control and operating efficiency.

A DECADE PAST

As the railroads have reshaped their networks to meet current and projected demand, the downward trend in Class I railroad mileage has run into a steady increase in ton-miles. A decade ago, railroads began to see capacity constraints. This prompted North American railroads to take steps to ensure that every piece of business was generating a satisfactory return on investment. Union Pacific Executive Chairman Jack Koraleski put the issue bluntly on a conference call: UP's strategy "is to price to reinvestable levels. And if we can't get to reinvestable levels, we'll walk away from the business."

Long-haul, high-value business appeals to railroads because the transportation cost represents just a small fraction of the value of the product, so railroads have a good shot at pricing their services aggressively in the marketplace.

Construction aggregates don't fit that pattern. Stone, sand, and gravel are found in every state from Florida to Alaska and every Canadian province from Nova Scotia to British Columbia. This means the business moves short distances, generally fewer than 300 miles.

In 2014, the average value of crushed stone quarried in the United States was $10.49 per ton. That's below the value of Powder River Basin coal's early May 2015 weekly spot price of $11.55 per ton. But the average length of haul for coal is greater, and the pricing environment in coal transportation is affected by factors that don't apply to construction materials. In short, railroads can charge more for moving coal than for moving rock.

Yet one inescapable fact about railroads and aggregates producers is that they're interdependent. Producers depend on railroads to meet a big share of their transportation needs, and railroads depend on producers for a key ingredient in their infrastructure: ballast. Look no further than Martin Marietta Materials' 2014 annual report which said, "two of the Corporation's top fifteen customers in 2014 were Class I railroads."

THE ROLE OF RAIL

Most crushed stone and gravel move in trainload lots, but these are not like the unit trains that move coal from Powder River Basin mines to electric generating stations. Rock trains often require switching at origin or destination because of track configuration, or the fact that a single trainload may represent shipments for two

Short-haul aggregates trains are a common sight on Class I railroads. This Union Pacific aggregates train heads east through California's San Timoteo Canyon. Elrond Lawrence

A front-end loader dumps crushed stone into an aggregates hopper at Lannon Stone Products Inc. in Sussex, Wis. Aggregates are found in all 50 states. TRAINS: Drew Halverson

or more distribution yards, or because customer volume requirements vary from day to day. Loading and unloading are typically slower, because of the loading equipment used and because cars in aggregates service are not equipped for rapid discharge. Aggregates often move in gondola cars, which are unloaded from the top using backhoes or other heavy equipment.

The Class I railroads prefer to focus on the line-haul, not switching at terminals. That's one key element in keeping costs down. The result is that customers have been required to make investments in trackage that can accommodate an entire trainload and allow efficient movement to and from a Class I railroad's main line.

It's also common to see both quarries and distribution terminals that operate their own locomotives [see "Ready Made for Ready-Mix," TRAINS May 2011]. Shortline railroads can also participate in rock moves. One example is the Marble Falls, Texas, quarry, about 50 miles northwest of Austin, operated by Capitol Aggregates Inc. The quarry is served by Watco Cos.' Austin Western Railroad, which interchanges with UP and BNSF Railway at McNeil, Texas. Trains use the road power belonging to the Class I railroad carriers, but operate with Austin Western personnel. When a solid train is being loaded, quarry employees operate the road power. For less-than-trainload shipments, loading is performed with a leased locomotive.

From the customer's perspective, the difference in cost between using rail and truck is important. In its 2014 annual report, Martin Marietta Materials says that the average cost per ton-mile for the three transportation modes that the company relies on come in at 15 to 35 cents per ton-mile for truck; 4 to 9 cents for rail; and 0.5 to 1.5 cents for water, which is unchanged from 2012. But water transportation is an impractical alternative for aggregates moving from inland quarries. As a consequence, Martin Marietta's rail use has risen dramatically. In 1994, the company moved 5 million tons by rail, but moved nearly 28 million tons in 2014 (up from 24 million in 2012).

Producers also promote the environmental benefits of rail to potential customers and the public. A March 2013 blog post by California's Graniterock said, "at Graniterock, one carload of rock carries the equivalent of eight truck-trailer one-way trips. Loads of rock, which originate at our A.R. Wilson Quarry in Aromas, Calif., and have a destination of San Jose, produce about one-quarter the carbon emissions of trucks. For every 10,000 tons of rock shipped by rail instead of by truck from Aromas to San Jose, there is a carbon reduction of 30 metric tons."

CLASS I ROCK MOVEMENTS

BNSF Railway moves most of its aggregates traffic within a three-state area: Texas, Oklahoma, and Kansas. Texas is, in fact, the largest producer and consumer of aggregates among the 50 states, and that region is the epicenter of the crushed-stone business for both BNSF and competitor UP.

Population growth in the Sun Belt has been a big driver of the rail aggregates business, which is why many BNSF rock trains terminate at distribution yards and construction sites around expanding metropolitan areas such as Houston and Dallas-Fort Worth. Although new residential starts fell precipitously after the start of the Great Recession in 2007, recent economic data point to an uptick in residential construction. New houses mean new roads, shopping centers, and schools, all of which generate demand for aggregates.

One factor that distinguishes the Texas rail aggregates business from that in other high-growth areas is that many destination facilities are temporary in nature. When major new construction begins in a previously unpopulated area, contractors work with railroads to find sites suitable for unloading stone to feed ready-mix plants and other consumers. Since these are temporary, they lack the unloading pits and other features found in more permanent distribution yards. Instead, gondola cars, as short as 42 feet, are used to move stone and are unloaded with backhoes.

BNSF moves crushed stone from several locations west of Interstate 35, such as the Texas Crushed Stone Co. quarry at Georgetown, Texas, and the Capitol Aggregates facility at Marble Falls, Texas, into the Houston and Dallas-Fort Worth areas.

An empty BNSF Railway aggregates train departs Fort Worth, Texas, in May 2013. Texas has multiple quarries that lie west of Interstate 35, where stone is easily recovered. Chris Guss

Canadian National SD60F No. 5411 leads a train climbing out of Duluth, Minn., with 17 limestone loads on May 11, 2013. Aggregates may freeze in railcars in winter, making this a seasonal commodity in northern U.S. states and Canada. Erik Shicotte

Canadian National serves about 10 quarries and gravel pits in Canada. In the U.S., CN's former Illinois Central main line parallels the Mississippi River for much of its length and faces stiff competition from lower-cost river barges. CN has one crushed-stone move on its former Wisconsin Central route, from a quarry in Sussex, Wis., to distribution yards in northern Illinois.

Bruno Demers, marketing director in CN's metals and minerals group, told TRAINS that there are several differences between the U.S. and Canadian aggregates markets. One driver of the Canadian business in recent years has been Alberta oil sands project developments.

Drilling sites for these projects require aggregates for good drainage, and CN has stepped in with crushed-stone moves to satisfy this need.

Higher Canadian weight limits for trucks also create a different competitive environment for the country's railroads. In fact, when the Canadian trade magazine Aggregates & Roadbuilding listed the country's top 10 aggregates operations by volume for the year 2009, none was rail-served; five listed their primary shipment method as truck, and five as water.

To state the obvious, winter weather has a bigger effect in Canada than in much of the U.S. Aggregates are susceptible to freezing in railcars, so the season for rail movements is typically limited to about half a year.

Working in CN's favor for the long term is the fact that sourcing of construction materials in the immediate vicinity of urban areas like Toronto and Edmonton, Alberta, is becoming more of a challenge, meaning that new sources are being developed at greater and more rail-friendly distances from those cities.

Two of CN's principal aggregates operations are in Alberta. One is for customer Lehigh Hanson, from a quarry at Cadomin, Alta., to the company's cement plant at Edmonton, about 180 miles away.

Another Alberta aggregates train operates on behalf of Standard General, a major supplier of construction materials in Edmonton. In 2008, the company opened its new Windfall Gravel Pit near Fox Creek, Alta., about 150 miles northwest of Edmonton. Rail was part of the equation from day one. The company moves up to 1.5 million tons of product each year from the Windfall pit to its distribution yard and asphalt plant at Acheson, just west of Edmonton, using 100-car trains consisting of specialized aggregates cars leased by Standard General. The equipment at Acheson enables a crew to unload a train in about 4 hours. For every 100 railcars handled, Standard General says it keeps 300 trucks off the highways, and reduces carbon dioxide emissions by 52 percent.

BY BEING ABLE TO PUT RAIL INTO THE PIPELINE OF THE CONSTRUCTION PROCESS, YOU REDUCE TRUCK TRAFFIC AROUND READY-MIX PLANTS AND OTHER FACILITIES. – PAUL HEYMANN, NORFOLK SOUTHERN AGGREGATES MARKETING MANAGER

Canadian Pacific is not a major player in the aggregates business in North America, but its officers are alert for opportunities in non-traditional markets. Take one long-term and one short-term breakthrough as examples of railroad managers' ingenuity.

David Walker, CP's project cargo director, found the first opportunity when he learned in 2008 that each of the three major CP-operated ballast quarries around the railroad had about a million tons of "reject" 1½-inch-diameter rock that had no known use. One of these quarries is near Cranbrook, British Columbia.

"We have a lot of business going into the oil sands area of Alberta," Walker says, "and customers in this area needed something that would pack relatively hard. We came up with the name 'engineered premium aggregate.' We went to Lafarge Canada to do a test on the rocks to make sure they would correlate with their needs, and they put in an order for 100,000 tons of it. The result was a movement to Edmonton, using 50 cars, that lasted one year."

Walker then learned that the light-rail system in Calgary, Alta., could use this premium aggregate in connection with new construction. That also was a tempo-

CSX Transportation serves this aggregate yard in Westport, Md., but much of the railroad's business is centered in Florida. Stone moves are typically less than 300 miles. Al Moran

A pair of six-axle Norfolk Southern units pull into a quarry in Clay Center, Ohio, with an empty stone train. The quarry is located on a former Conrail line. Thomas J. Nanos

rary move, but led to a longer-term relationship with the city of Calgary, which now plans to purchase approximately 10,000 tons annually of 3½- to 4½-inch ballast product from Canadian Pacific for light-rail maintenance.

CP found that the best cars for this service would be 52- or 65-foot gondolas, which can be loaded to about 100 tons. At origin, a front-end loader with a scale is used to load cars. At destination, a backhoe unloads the product and empties 90 to 95 percent of the car, while the rest is shoveled out manually. The equipment is dedicated to the service, which operates from April through November.

CSX Transportation serves rock quarries in 13 states, but its most significant concentration of aggregates business is in the southeastern corner of its network, driven by growth of major urban areas in Florida. Much of CSX's stone business in northern and central Florida originates at quarries in Georgia. In south Florida, the largest part of the business is shipped from two quarries in the Miami area. Near Florida's panhandle, most rock originates at Alabama quarries.

According to Derrick Smith, CSX's vice president of emerging markets, more than two-thirds of the railroad's aggregates business involves hauls of fewer than 300 miles. He says, "We work with customers to make sure that they are able to handle trainload volumes. Volumes less than trainload make the economics more challenging."

CSX acts as though this business is reinvestable. The railroad, which already owned a fleet of aggregates cars, has put new capital into this business to buy cars that have high capacity, low tare weight, and include rapid-discharge equipment that will improve turnaround times.

One of CSX's major aggregates customers is Conrad Yelvington Distributors Inc., based in Daytona Beach, Fla., which was acquired by Oldcastle Materials Inc. in 2007. Conrad Yelvington has operations in Florida, Alabama, Mississippi, and South Carolina. The business started out as a family-run trucking operation, but Florida's rapid population growth in the 1970s and 1980s fueled a building boom that led to significant increases in the company's business. That, in turn, led Conrad Yelvington to begin using rail in the early 1980s to move aggregates to distribution yards in places like Orlando, Tampa, and Jacksonville. By 2007, the company was moving about 10 million tons of rock annually by rail to its 28 terminals, using 1,800 leased cars. In 2010, the company shipped its one-millionth carload.

Volumes were affected by the steep decline in construction activity that began in 2007, but today Conrad Yelvington still has a fleet of 1,300 open-top hoppers that the company uses to move aggregates. One big source is the Warren County Quarry in Camak, Ga., operated by another Oldcastle subsidiary, APAC Mid-South Inc. Conrad Yelvington also sources material from Vulcan, Martin Marietta, and CEMEX USA quarries. Gary Yelvington, Conrad Yelvington's president, said that 27 years ago, a standard train length was 60 cars; within the past few years, Conrad Yelvington operated trains as long as 100 cars to qualify

Seven Union Pacific EMDs lead a rock drag over the San Bernard River trestle near East Bernard, Texas. Tom Kline

for low aggregates freight rates.

Conrad Yelvington has a fleet of 28 locomotives to handle railcars at its distribution terminals, and because the producer uses CSX trackage to move equipment between terminals within urban areas, its rail unit is treated as a Class III railroad by the Federal Railroad Administration. Conrad Yelvington rail personnel who operate over CSX track are fully qualified on CSX operating rules, and the aggregates company's locomotives meet FRA standards.

Norfolk Southern serves 67 quarries, 30 aggregate distribution yards, and 15 cement plants. The railroad has several regular movements of aggregates in eastern Pennsylvania. Another area that sees regular crushed-stone movements is northern Virginia, where NS trains carry crushed rock from Vulcan Materials' Manassas quarry to ready-mix concrete and hot-mix asphalt plants serving the Washington area.

NS serves quarries in Virginia, the Carolinas, Georgia, and Alabama, but the railroad also serves quarries in the northern part of its system, such as the quarry in Clay Center, Ohio, operated by Oldcastle Materials' Shelly Co. subsidiary.

Jim Wilson, marketing director for Norfolk Southern's metals and construction team, and Paul Heymann, aggregates marketing manager, say the railroad has a diverse mix of unit train, trainload, and carload shipments, as well as a mix of railroad-owned and privately owned cars. "We have some baseload lanes that we know we'll handle year in, year out," says Wilson, the marketing director. "But there are always special projects that pop up, such as for a power plant construction. Their duration could be as short as two months. In the Marcellus Shale area of western Pennsylvania, where there are numerous oil and gas projects under way, there is big demand for aggregates for construction and well-pad development."

The key to making this business a success, Heymann says, hinges on how quickly the railroad can cycle trains and efficiently run them across the rail network. The faster NS turns the cars, the better the economic return for the railroad on its investment in cars, locomotives, and track. Railroad customers also have a better return on their investments in track to serve origin and destination facilities, as well as loading and unloading equipment such as bucket loaders, pits, and conveyors.

Union Pacific, like BNSF, is heavily involved in the Texas aggregates market, and thanks to trackage rights associated with the Burlington Northern-Santa Fe merger

WHAT ARE CONSTRUCTION AGGREGATES?

Construction aggregates fall into two broad categories: crushed stone, and sand and gravel. Crushed stone consists of rock, including limestone or dolomite, but also granite and other rocks extracted from a quarry through blasting, and then crushed and screened to specific sizes before moving to construction sites or distribution yards. Sand and gravel is loose material, excavated from a pit, screened, and sometimes washed before being shipped to its destination. Altogether, the total output of construction aggregates in the United States in 2014 was almost 2 billion metric tons, of which 65 percent was crushed stone and the balance sand and gravel.

Authors of a 2015 U.S. Geological Survey report said that in 2014, crushed stone valued at more than $12.8 billion was produced by 1,550 companies operating 4,000 quarries, 91 underground mines, and 210 sales-distribution yards. Construction sand and gravel valued at $7 billion was produced by an estimated 4,100 companies and government agencies from about 6,600 operations for the same year.

Geological Survey analysts also estimate that 82 percent of the 2014 U.S. production of crushed stone was used as construction material, mostly for road construction and maintenance — as base material and the major ingredient in asphalt — and for drainage applications such as railroad ballast. Analysts say that 43 percent of the sand and gravel produced was used as concrete aggregates, 26 percent for road base and coverings and road stabilization, and 24 percent in asphalt, other bituminous mixes, and construction fill. This is an industry with numerous local and regional participants, but there are several North American companies whose crushed stone and gravel operations extend from coast to coast and border to border, and occasionally beyond the border, with operations in both the U.S. and Canada. — *Tom Murray*

FREIGHT CARS FOR THE ROCK BUSINESS

The modern aggregates open-top hopper car looks like a rectangular box about 32 feet in length placed onto a platform roughly 45 feet in length, extending a bit more than 6 feet beyond the end of the box at either end of the car. FreightCar America Inc., National Steel Car, and TrinityRail all offer this type of car for the North American market. Other cars used in the North American market include four-bay, two-bay, and three-bay hoppers, gondolas, and side-dump gondolas.

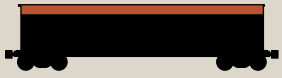
TYPES OF AGGREGATE CARS

Modern aggregates hopper (2,400 cu. ft., 286,000 g.w.)

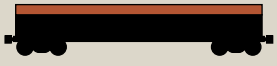
Standard 4-bay hopper (4,000 cu. ft., 286,000 g.w.)

Standard 2-bay hopper (2,300 cu. ft., 263,000 g.w.)

Gondola (2,480 cu. ft., 286,000 g.w.)



Side-dump gondola (1,350 cu. ft., 263,000 g.w.)



Not to scale, discharge area shown in color

A conveyor shows crushed rock uniformity as it loads into a hopper at Capitol Aggregates' Marble Falls, Texas, quarry in 2008. Two photos, Forrest Becht

It is counter-intuitive, but railroads quietly wait for U.S. highway projects that will demand more aggregates. Stone in these hoppers is destined for road construction.

of 1995 and UP's purchase of Southern Pacific in 1996, they compete head-to-head for Texas business.

But there are other markets where UP has exclusive access to customers. Two such operations are in Southern California:

• From Cabazon, on UP's Sunset Route east of Los Angeles, the railroad moves crushed rock for Robertson's Ready Mix, a major LA-area concrete and construction products company. The destination of these trains is Robertson's Gardena cement plant, 13 miles south of downtown Los Angeles. The rail route is about 95 miles long.

• From Littlerock, near Palmdale, UP moves trainloads of crushed stone through Soledad Canyon to a Vulcan facility at Sun Valley, near North Hollywood, a distance of about 50 miles.

"FOR EVERY 10,000 TONS OF ROCK SHIPPED BY RAIL INSTEAD OF BY TRUCK FROM AROMAS TO SAN JOSE, THERE IS A CARBON REDUCTION OF 30 METRIC TONS." – GRANITEROCK

WHAT THE FUTURE HOLDS

Aggregates companies were among those hurt by the economic slide that started in 2007. Even with a slight improvement in new construction since January, it seems unlikely that the pace of construction that was last seen in 2007 will return soon.

One of the nagging difficulties, both for the railroads and their aggregates customers, is the lack of a long-term U.S. transportation funding plan. The federal gasoline tax of 18.4 cents per gallon, which is earmarked mostly for highway construction, was last increased in 1994; its yield has been eroded not only by inflation but by the trend toward more fuel-efficient cars.

Despite negative news, railroad representatives interviewed for this story sounded upbeat about the state of the rail aggregates business.

CSX's Derrick Smith says that his company has learned how to make money in this market. "The key to making this an attractive business from our standpoint is that we have efficiencies to ensure that it generates a satisfactory return on investment. We have been successful in meeting this objective," Smith says.

At Norfolk Southern, Paul Heymann says two-year federal highway transportation bills limit the planning horizon for NS customers such as state transportation departments. In turn, this makes the railroad's future volumes less predictable.

"We support new highway construction even though this may help our truck competitors. By being able to put rail into the pipeline of the construction process, you reduce truck traffic around ready-mix plants and other facilities," Heymann says.

While the future is by no means certain, railroads have established themselves as a vital link in the aggregates supply chain, and through their relentless efforts to improve efficiency, have found ways to make their rock business profitable. T

TOM MURRAY is a longtime Trains *contributor and railroad analyst.*

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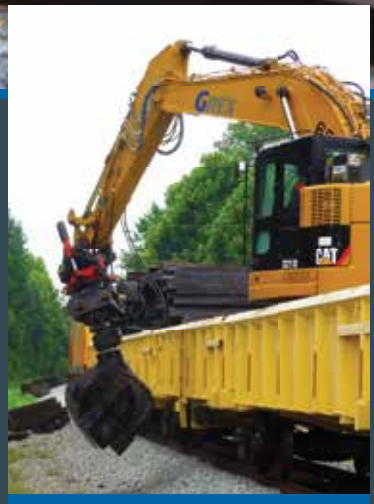

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