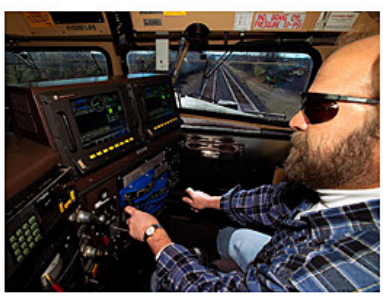
CONSERVATION / FUEL EFFICIENCY

Fuel Efficiency Improves in 2014



Norfolk Southern locomotives operating in revenue service achieved an overall 2.2 percent gain in fuel efficiency in 2014.

During the year, revenue trains burned nearly 494 million gallons of diesel fuel while rolling up 205 billion revenue ton-miles. On average, the trains moved a ton of freight 415 miles on a gallon of diesel, up from 406 miles in 2013.

The efficiency gains translate into diesel fuel savings of roughly 10.8 million gallons and avoidance of more than 109,500 metric tons of greenhouse gas emissions. The improvement is attributed in large part to LEADER train-handling technology. In 2014, about two-thirds of the company's long-haul locomotives were equipped with the technology, and 2014 marked the first full year that data management systems were in place to run LEADER trains across the entire network.

The locomotive fleet's fuel economy varied during the year based on weather, operating conditions, and freight mix. Best performance was achieved during the third quarter, when trains moved a ton of freight an average of 443 miles on a gallon of diesel. Worst performance came during the first quarter, with an average of 374 ton-miles per gallon. Snow and bitter cold created congestion that increased train idling and the use of shorter trains, contributing to fuel economy declines.

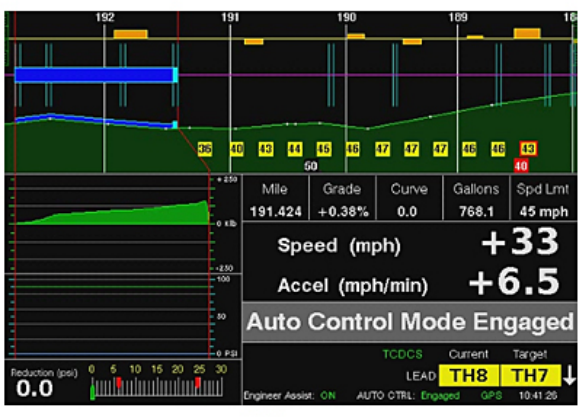
Fast Facts: What is LEADER?

LEADER, Locomotive Engineer Assist Display Event Recorder, is train-handling software integrated into locomotive operating systems. The GPS-based LEADER monitors a train's operating conditions and calculates the speed and dynamic braking required for maximum fuel efficiency. Train crews use an onboard touch-screen computer to operate LEADER.

Use of LEADER

Mid-2015 Status:
Installed on 1,770 road locomotives, two-thirds of Norfolk Southern's long-haul fleet

Results:
5 percent average fuel-efficiency gain. Fuel savings vary depending on train weight and length, track profile, and other operating factors.



A LEADER console display

Milestones

2003:
First tests on locomotives on a 105-mile stretch of hilly, curvy track in the Blue Ridge Mountain foothills between Roanoke, Va., and a power plant near Winston-Salem, N.C.

2009-2010:
Helicopters with infrared laser technology and GPS-based cameras are used to record data needed to create a digital network map for 16,000 route-miles of overland track, necessary for LEADER to calculate train operating conditions.

2010:
Main lines on the railroad's Northern Region between Chicago and Croxton, N.J., become the first equipped with the infrastructure needed to run trains with LEADER-equipped locomotives.

2013:
Divisions across all three of the railroad's operating regions achieve ability to run trains pulled by LEADER-equipped locomotives.

2014:
Successful pilot of a new auto-control feature.

2015:
Rollout of auto-control on Georgia Division and locomotive engineer training.

Saving Fuel with LEADER

Norfolk Southern in 2014 continued to advance development of LEADER train-handling technology, the railroad's flagship fuel-efficiency initiative.

During the year, the company piloted a new auto-control feature that enables LEADER to automatically adjust a locomotive's throttle speed and dynamic braking. Rollout of the new feature is occurring during 2015, starting on the railroad's Georgia Division.

Before auto-control, a "prompt" on a computer screen advised locomotive engineers of fuel-saving opportunities. The engineer had to react to the prompt, decide what to do, and then physically adjust the throttle and dynamic brake settings.

LEADER's auto-control feature is similar to automobile cruise control. All locomotive engineers need to do is turn on auto-control at the start of a train run, enabling LEADER to make speed and brake adjustments. By removing human reaction time from the equation, the company expects auto-control to generate additional fuel savings.

Norfolk Southern worked with industry partner New York Air Brake, the LEADER software designer, on the upgrade, designing the hardware that integrates LEADER into a locomotive's operating system. The pilot was conducted on about 75 locomotives over an estimated 2,500 track miles of various terrain.

"It has performed exactly as we expected it to," said Jon Collins, manager locomotive systems and special projects. "It takes a lot of the busywork out of operating a train and allows engineers to focus on the big picture. You manage a train operation versus executing every little piece of it."

Future Fuel Gains Ahead

Norfolk Southern plans additional LEADER enhancements to further boost fuel savings. One would enable LEADER to independently manage the throttle and brake settings of several locomotives in a consist. Individual engines would be used only when power is needed, thus conserving fuel.

Another initiative will integrate LEADER into the company's RailEdge Movement Planner system, which became operational systemwide in March 2015. Movement Planner, developed through a partnership between Norfolk Southern and GE Transportation, is capable of creating train movement plans across the company's network, looking eight hours ahead to calculate the most efficient train routes. By linking LEADER's energy management capabilities to Movement Planner, the railroad can pace trains across the network to achieve maximum fuel efficiency and optimal customer service.

Mining Fuel Efficiencies Across the Railroad

Norfolk Southern has significant environmental and economic reasons to improve locomotive fuel economy. In 2014, the railroad spent nearly $1.6 billion on fuel – the second single largest railway operating expense behind employee compensation and benefits. The diesel-burning locomotives also generate about 90 percent of the company's annual greenhouse gas emissions. Investing in technologies and operating efficiencies to reduce fuel consumption and emissions is good business.

While LEADER train-handling technology is Norfolk Southern's primary fuel-efficiency initiative, the company has multiple efforts underway to reduce locomotive fuel consumption and emissions.

This broad-based approach includes the following:

REDUCED TRAIN IDLING	Locomotives are outfitted with idle-reduction technologies that help eliminate unnecessary idling in winter weather. These automatic engine stop-start microprocessor systems monitor engine temperature and shut off or restart engines. The company has improved on this with in-house development of a plug-in engine heater system. In addition, the company's idle-reduction policy requires that locomotives be shut off unless there is an operational need for them to remain idling.
REDUCED WHEEL/RAIL FRICTION	Working with industry partners, the railroad's Research and Test Department has helped pioneer technologies that lower fuel use and track maintenance costs by reducing friction between wheels and rails. A major initiative is top-of-rail friction-control systems. Installed on routes with high curvature and heavy tonnage, these solar-powered wayside systems dispense a lubricant that reduces the amount of energy needed to move the train and reduce track damage caused by steel wheels on rail. In 2014, the company began using a new modifier the research department helped develop that is effective over longer stretches of rail. The new material has enabled the company to reposition existing applicators to expand coverage without purchasing new equipment. Because they are solar-powered, the systems conserve energy and can be placed in remote locations where commercial power is unavailable.
WAYSIDE DETECTORS	Installed on the railroad's busiest and heaviest tonnage routes, these remote sensors enhance safety of operations, reduce fuel use, and lower track maintenance costs. These devices include wheel-impact detectors that identify defective rail car wheels and acoustic wheel-bearing detectors that predict bearing failures before they cause problems.
DISTRIBUTED LOCOMOTIVE POWER	This technique, used primarily on heavy unit trains, involves placing locomotives at intermediate points on a train to distribute pulling power and maximize fuel efficiency.
WHEEL BEARINGS	At wheel renewal change-outs, the company installs low-torque roller bearings that generate fuel savings estimated at 1 to 2 percent compared with older bearings they replace.