

# Driving Emissions and Energy Efficiency

Operating efficiently has been the hallmark of our success. We continue to lead the North American rail industry, consuming 15% less fuel per gross ton mile overall than the industry average, and our rail fuel efficiency innovative mindset extends to all aspects of our business.

## Reducing Our Rail Carbon Footprint

With approximately 84% of our GHG emissions generated from rail operations, we believe the single best way we can positively impact the environment is by continuously improving our locomotive operating efficiency.

Over the years, the pursuit of efficiency has been the hallmark of our success. Today, we are using fewer railcars and locomotives to ship more freight in a tight, reliable and efficient operation for our customers. As part of our ongoing strategy to operate a productive and

fluid railroad, further improvements have been made through our Fuel Management Excellence program.

### Innovative Rail Technologies and Renewable Fuels

We continue to purchase tier-compliant locomotives as part of our strategy to acquire, retire and upgrade our fleet, and in 2016, we acquired 90 new high-horsepower locomotives. Furthermore, the installation of fuel-efficient technologies, such as locomotive telemetry systems and Trip Optimizer,

in addition to distributed power and the use of renewable fuels, helped us further reduce emissions. In 2016, the use of renewable fuels saved more than 60,000 tonnes of carbon, representing 1.2% of our total emissions.

### Routing Protocols and Port Agreements

Routing protocol agreements with all the Class I railroads continue to facilitate the movement of customer shipments in the most efficient way regardless of track ownership. We also collaborate with ports and terminal operators to improve dwell times and further drive efficiency.

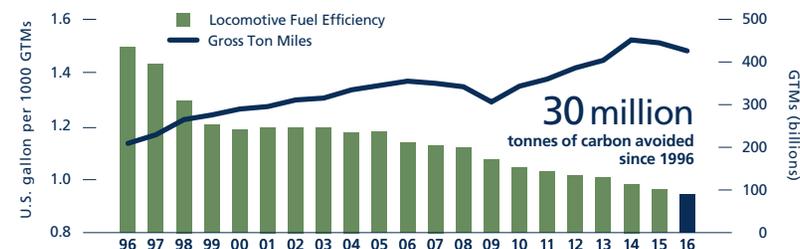
### Fuel Conservation Practices

Our train crews and rail traffic controllers are continuously being trained on best practices for fuel conservation, including locomotive shutdowns in our yards, streamlined railcar handling, train pacing, coasting and braking strategies. In 2016, we decreased train idling by 14%.

**37%** improvement in fuel efficiency since 1996

#### LOCOMOTIVE FUEL EFFICIENCY

vs. Gross Ton Miles (GTMs)



SPEAKER'S CORNER

## Using Renewable Fuels for Our Fleet

*“Driven by regulatory requirements, the growth of the renewable fuel market has presented an important opportunity for us to further reduce our emissions by using biodiesel blends in our locomotive fleet. In 2016, the use of renewable fuels saved over 60,000 tonnes of carbon.”*

*In the coming years, we look forward to working with our suppliers to explore the use of renewable fuels, ensuring we meet our efficiency objectives and compliance obligations.”*

**CARMEN TANABE**  
Director, Supply Management

Over  
**60,000** tonnes

OF CARBON AVOIDED BY USING RENEWABLE FUELS IN OUR LOCOMOTIVES

**PICTURED:**

Our new Tier 4 locomotives are designed to meet regulatory standards producing less criteria air contaminants, while being much more fuel-efficient than the locomotives they replace.

Photo by CN employee  
Tim Stevens

## SPOTLIGHT

# Improving Fuel Efficiency through Analytics and Big Data Management



Our innovative rail technology applications and analytics capabilities are helping us continuously improve our carbon footprint.

*“Our significant investments in innovative fuel-efficient technologies and data analytics capabilities are really paying off. Between 2008 and 2016, fuel efficiency gains have translated into more than 4 million tonnes of carbon saved.”*

**CARLO PAGANO**  
Director, Asset Planning and  
Technical Development

These technologies include:

- **Trip Optimizer** – Regulates the speed of a train by controlling the locomotive throttle and dynamic brake, and computes the most efficient manner to handle the train. At the end of 2016, Trip Optimizer became operational on almost 490 GE EVO locomotives.
- **Locomotive Telemetry System** – Collects data to drive improved locomotive and train performance, including fuel conservation. Our Horsepower Tonnage Analyzer (HPTA) also uses the data from the system to optimize a locomotive’s horsepower-to-tonnage ratio.
- **Distributed Power (DP)** – Allows for remote control of the locomotives and improves braking performance, train handling and fuel efficiency. In 2016, we added 90 AC locomotives with DP to our fleet, bringing the total to nearly 770 locomotives.

We ensure our locomotive engineers receive on-the-job training on technologies to optimize fuel consumption. Regional managers are also provided with information to track performance. Our future focus will be on excess idling reduction and continued horsepower optimization.



## 1 Increasing Fuel Efficiency with Distributed Power

In addition to improved safety from reduced sticking brakes and damaged wheels, we are improving braking performance, train handling and fuel efficiency.

## 2 Regulating Speed with Trip Optimizer

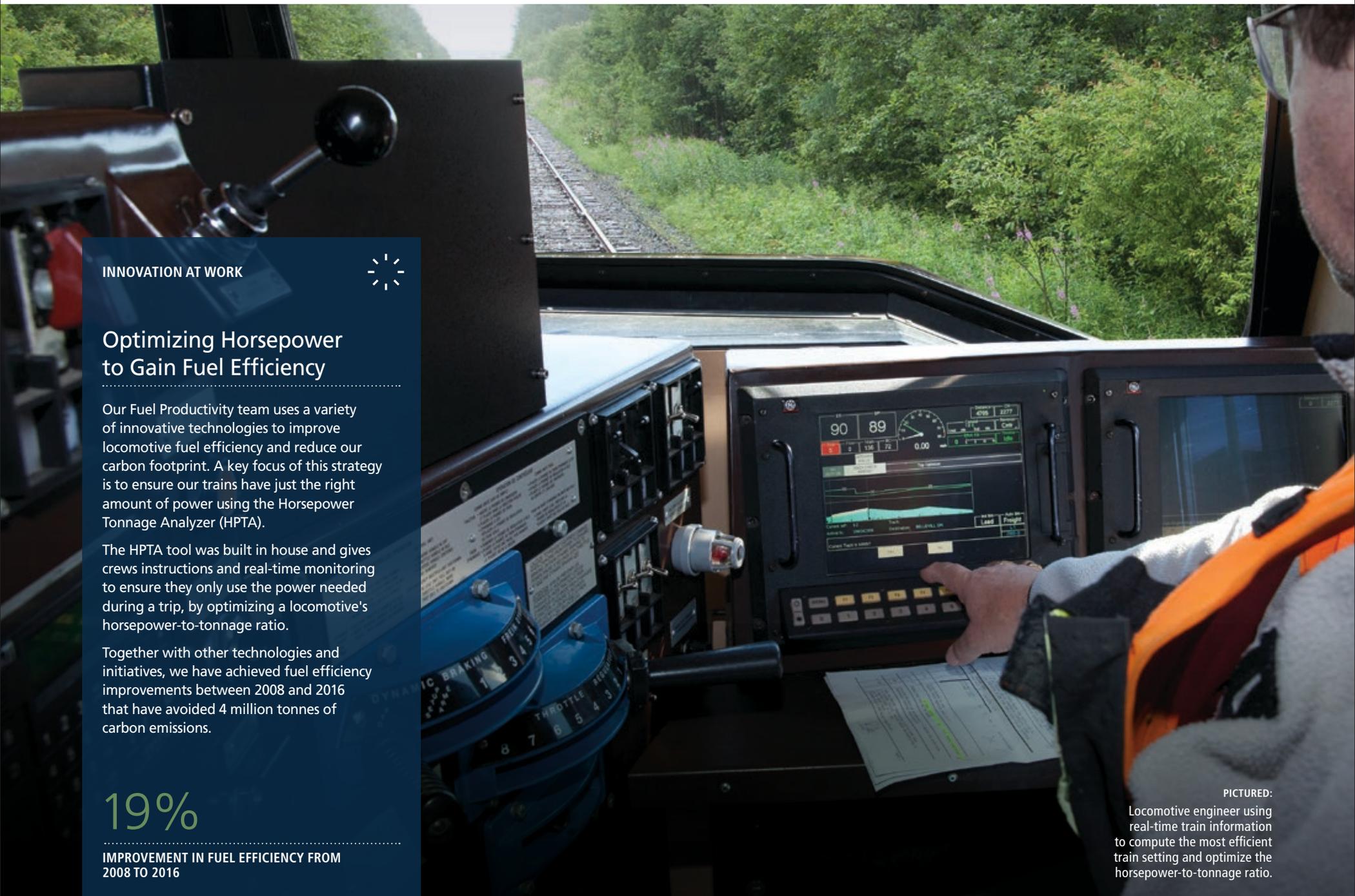
Locomotive Engineer Raymond Phinney receiving real-time information on train characteristics, performance and terrain, helping to continuously compute the most efficient train settings.

## 3 Collecting Data with Locomotive Telemetry System

We are wirelessly communicating operational data from locomotives to a central system, allowing Horsepower Tonnage Analyzer to optimize a locomotive’s horsepower-to-tonnage ratio.

# 4 million tonnes

OF CARBON AVOIDED FROM  
2008 TO 2016 THROUGH  
FUEL EFFICIENCY IMPROVEMENTS



INNOVATION AT WORK



## Optimizing Horsepower to Gain Fuel Efficiency

Our Fuel Productivity team uses a variety of innovative technologies to improve locomotive fuel efficiency and reduce our carbon footprint. A key focus of this strategy is to ensure our trains have just the right amount of power using the Horsepower Tonnage Analyzer (HPTA).

The HPTA tool was built in house and gives crews instructions and real-time monitoring to ensure they only use the power needed during a trip, by optimizing a locomotive's horsepower-to-tonnage ratio.

Together with other technologies and initiatives, we have achieved fuel efficiency improvements between 2008 and 2016 that have avoided 4 million tonnes of carbon emissions.

# 19%

IMPROVEMENT IN FUEL EFFICIENCY FROM 2008 TO 2016

PICTURED: Locomotive engineer using real-time train information to compute the most efficient train setting and optimize the horsepower-to-tonnage ratio.

## Reducing Our Non-Rail Carbon Footprint



New low voltage LED lights that were installed recently at CN's Scotford Distribution Centre Yard outside of Edmonton provide more light using less energy.

### Non-Rail Fleet

Our non-rail fleet represents approximately 9% of our Scope 1 and 2 emissions, including intermodal equipment, trucking, On Company Service (OCS) vehicles, and our fleet of eight Great Lakes shipping vessels. Improvements in fuel efficiency continue to be driven by several projects.

Working with our owner-operated CNTL trucking fleet, we developed fuel efficiency standards and continued to provide training on various fuel-efficient initiatives, including aerodynamic

components and trucks, and routing optimization initiatives. We also trained our OCS drivers and ship operators on better fuel handling practices that reduce speed, engine running and idling time.

This year we plan to convert one of our steam boiler/turbine-powered vessels to an EPA emission compliant diesel engine to reduce emissions and burn less fuel. For one vessel conversion, we expect to reduce our carbon emissions by 41%, equivalent to saving over 12,000 tonnes of carbon annually.

# 22%



**CARBON REDUCTION FROM ELECTRICITY SAVINGS AT KEY YARDS SINCE 2011, AVOIDING 65,000 TONNES OF CARBON**

Transitioning our existing intermodal equipment shunt trucks from diesel to compressed natural gas (CNG) has been ongoing. We are also currently working with a new manufacturer to design and build state-of-the-art CNG shunt trucks that are more customized to our needs.

### Buildings and Yards

Buildings and yards account for approximately 7% of our carbon emissions, comprising electricity, natural gas and miscellaneous fuel consumption. Over the past few years, we undertook various energy efficiency projects through our EcoConnexions employee engagement program in collaboration with Facilities Management that included upgrades to air compressors, boilers, HVAC systems, and lighting.

For example, at the Chappell Yard in Saskatchewan and the Battle Creek Yard in Michigan, we expect to save up to 884,000 kWh of energy and avoid over 600 tonnes of carbon annually by upgrading to the yard air compressor systems. Since 2011, we have achieved reductions of 16% in energy consumption and 22% in carbon emissions at the yards where we implemented energy efficiency projects and engaged employees.



**SPEAKER'S CORNER**

### Conserving Energy at our Transload Facilities

*“Through the EcoConnexions program, we extended our energy conservation values to our transloading operations. A lot of work went into initial planning to determine the best employee engagement strategy. Today, the program has been rolled out to 28 transload facilities.*

*Two of the facilities – Concord, ON, and Scotford, AB – recently received funding for large lighting projects, resulting in 54 tonnes of carbon saved annually – equivalent to heating six homes a year.*

*I am so proud of the difference the EcoConnexions program is making to create an eco-efficient, cleaner and safer work environment.”*

**DINA MARTIN**  
Market Manager, Distribution Services  
Montreal, QC



PICTURED:  
Joe Farias, Foreman at MacMillan Yard, next to a new CN On Company Service vehicle with EcoConnexions anti-idling and speed limit decals applied to help improve safety and performance of the fleet.

INNOVATION AT WORK



### Using Technology to Drive Better Fleet Performance



Through next-generation telematics – GPS, wireless communications, and computing – we are capturing important data on our On Company Service (OCS) fleet, including speed, location, engine running time and idling times.

Last year, EcoConnexions created an anti-idling decal to remind drivers to turn off their engines during non-essential activities, as well as a rear bumper sticker advising the public that CN vehicles obey speed limits.

J-J Dratva, Director, Supply Management – Fleet Services, notices the impact. “The combination of technology and behaviour changes really makes a difference. Since 2015, we have decreased speeding by 37%, helping us be safer, while reducing fuel consumption and carbon emissions.”