

# Emissions and Energy Efficiency

## Why It Matters

We believe an integral part of our success depends on our ability to mitigate the impact of, and adapt our business to, changing climatic conditions. Our carbon footprint covers our rail locomotive fleet, non-rail vehicle and vessel fleets, and buildings and yards. With 85% of our GHG emissions generated from rail operations, emissions reduction in this area is an ongoing priority.

## Our Initiatives

### Reducing Our Rail Carbon Footprint

Our rail efficiency initiatives take place on several levels, from our Precision Railroading initiatives to our Fuel Management Excellence (FMX) program, which includes fleet acquisitions, new technology applications, efficient train handling techniques, yard locomotive operations and other collaborations across our value chain.

### Reducing Our Non-Rail Carbon Footprint

Building on our leading rail fuel efficiency programs, we have extended our efficiency mindset to our non-rail operations. We have implemented several projects such as new technology applications and training to improve the efficiency of our intermodal equipment and trucking fleets, On Company Service (OCS) vehicles and our Great Lakes shipping vessel fleet.

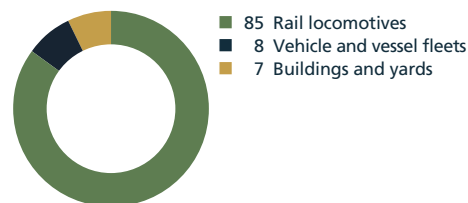
### Extending Our Efficiency Mindset to Our Building and Yard Operations

We have also taken steps to improve energy efficiency at our buildings and yards, focusing mainly on natural gas and electricity consumption. Projects include equipment upgrades, new sustainable building design specifications, IT system enhancements and employee training.

**85%** of GHG emissions from rail locomotives

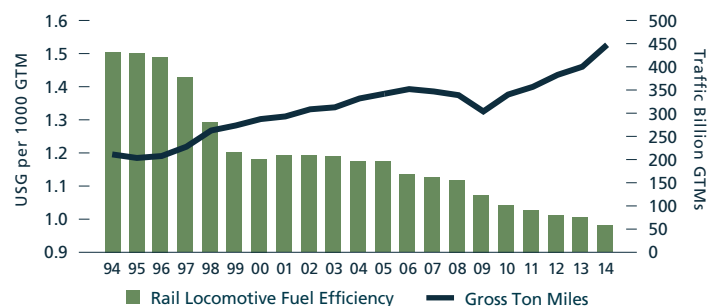
### 2014 Carbon Footprint

% of total GHG emissions (scope 1 and 2)



**35%** improvement in fuel efficiency since 1994 while achieving record traffic growth

### Rail Locomotive Fuel Efficiency vs. Gross Ton Miles (GTM)



### STAKEHOLDERS ASK:

**Q. How is CN the industry leader on fuel and carbon efficiency?**

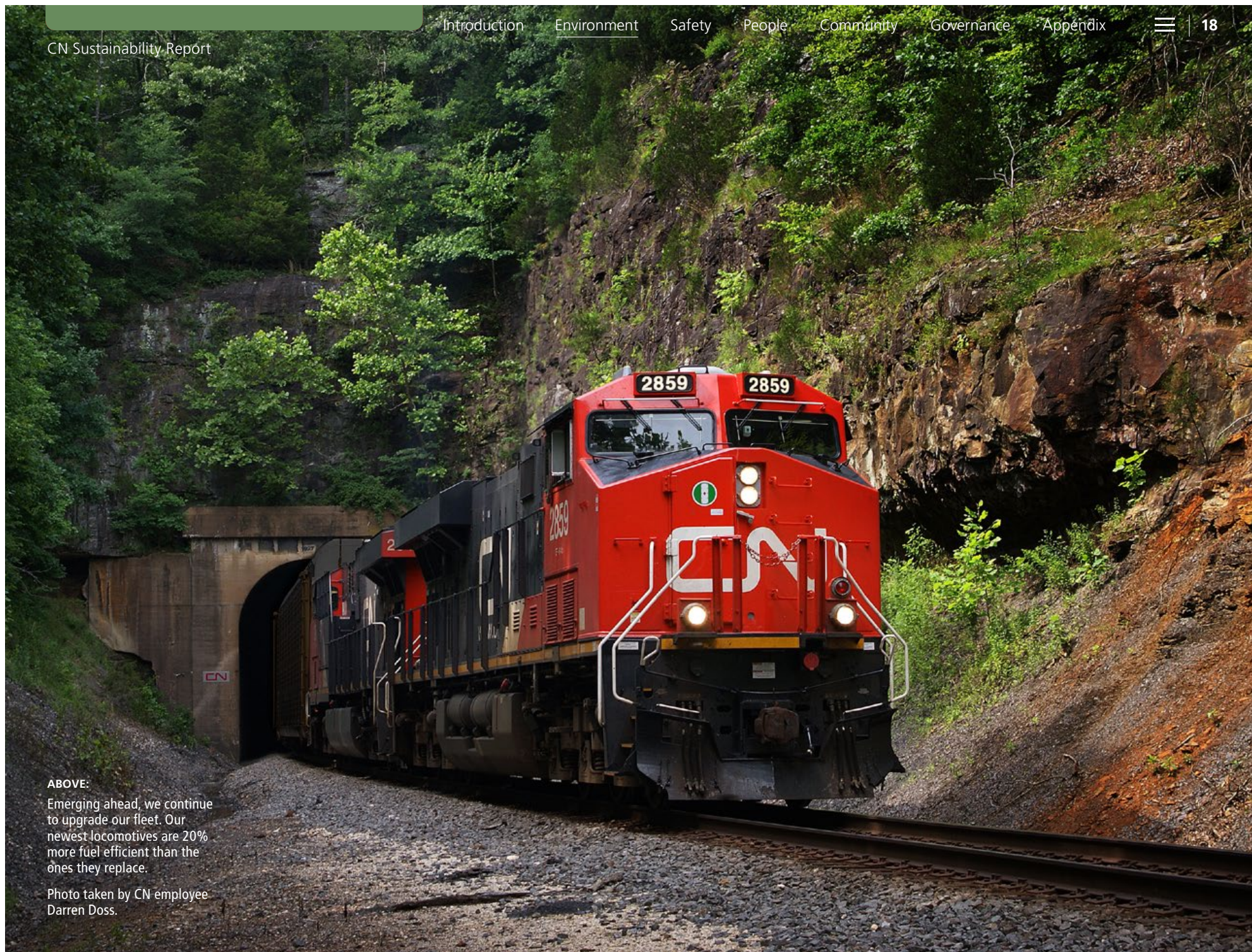
**A.** Over the years, the pursuit of efficiency has been the hallmark of our success. With Precision Railroading, fuel efficient locomotives, leading edge technology and numerous other programs, we achieved a fuel and carbon efficiency improvement of 35% over the past 20 years. Today, we lead the North American rail industry, consuming 15% less fuel per gross ton mile overall than the industry average.

We are committed to doing all we can to continuously improve our efficiency.

### CARLO PAGANO

Director Supply Management  
Transportation/Technology Services





**ABOVE:**

Emerging ahead, we continue to upgrade our fleet. Our newest locomotives are 20% more fuel efficient than the ones they replace.

Photo taken by CN employee Darren Doss.



# Reducing Our Rail Carbon Footprint

With 85% 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 and reducing our carbon footprint.

## Our Initiatives

### Using Fewer Rail Cars and Locomotives to Ship More Freight

For many years, we have operated with a mindset that drives efficiency and asset utilization, enabling us to become the most fuel and carbon efficient railroad in North America. Our asset-lean Precision Railroading model allows us to use fewer railcars and locomotives to ship more freight in a tight, reliable and efficient operation.

Our continued search for efficiency is best captured in our performance according to key operating metrics such as car velocity, train speed and locomotive productivity. All are at the centre of a highly productive and fluid railroad operation, enabling us to run even more fuel and carbon efficient trains despite increasing volumes in freight.

### Leading the Industry in Rail Fuel Efficiency

15%

less fuel per gross ton mile than the industry average



### Operating through Efficient Routing Protocols

Our routing protocols ensure we move traffic in the most efficient way, regardless of track ownership. We currently have routing protocol agreements with all Class I railroads.

### Driving Efficiency Across the Supply Chain

In addition to routing protocols and co-production arrangements, we are collaborating from end to end with ports and terminal operators, through agreements that focus on improving dwell times and driving efficiency, further enabling us to reduce GHGs and ensure better service for our customers.

### Upgrading Our Locomotive Fleet

We continue to acquire new, fuel efficient locomotives and upgrade our existing fleet. These new locomotives enable us to meet Tier 3 and 4 regulatory obligations, are up to 20 percent more fuel efficient than the ones they replace and produce at least 40 percent less nitrogen oxides. In order to tap into the opportunities related to alternative fuels, we are working with manufacturers and research centers to support the development of cleaner fuel alternatives, including natural gas.

For example, in 2014 we successfully retrofitted two high-horsepower mainline locomotives to run on a mix of liquefied natural gas (LNG) and diesel. Four special tender cars were also constructed for the trains to carry the LNG.



STAKEHOLDERS ASK:

## Q. How is CN responding to changing weather conditions?

**A.** Severe weather conditions, such as extreme cold or heat, flooding, drought, and hurricanes, can disrupt our operations, damage infrastructure, and affect the performance of our locomotives and rolling stock.

Year over year, we invest significantly towards the maintenance of our track infrastructure to protect our assets. In 2014, for example, we invested approximately \$1.25 billion. We also allocate operating expenditures towards proactive inspections, maintenance, emergency response and readiness plans, which include procedures for train speed, train length and weight, rail replacements, de-stressing and fire prevention and response.

**DAVID FERRYMAN**

Vice-President System Engineering

### Deploying Leading Edge Technologies

We maintain a longstanding commitment to reducing emissions by investing in innovative fuel efficiency technologies such as Trip Optimizer and locomotive telemetry systems. Trip Optimizer works like an advanced auto-pilot for locomotives, calculating the locomotive's ideal speed to minimize braking and increase fuel efficiency.

Locomotive telemetry systems wirelessly collect operational and performance data on locomotives, and distribute this information to a central location where real-time decisions and data analysis can be completed to assess a train's operations and fuel efficiency. This technology's data feeds our HPTA (Horse Power Tonnage Analyzer) system which works to optimize a locomotive's horsepower to tonnage ratio.

For example, if a train is overpowered, the crew would receive instructions to shut down one of the units or reduce the notch at which it is operating so that it can conserve fuel and as a result produce fewer emissions.

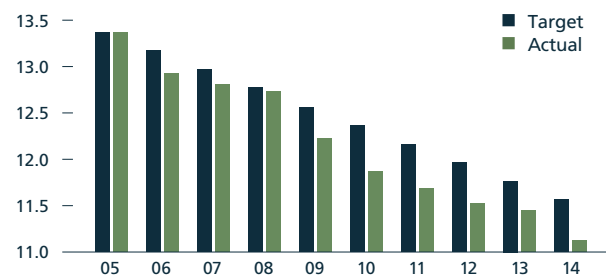


**IMPROVING FUEL EFFICIENCY WITH DISTRIBUTED POWER:** Locomotives equipped with distributed power allow CN to run longer, more fuel efficient trains, particularly in cold weather conditions, while improving train handling and the overall safety of operations.

**17%** reduction since 2005, exceeding our target of 15%

### Rail Locomotive GHG Emissions Intensity

tCO<sub>2</sub>e per million gross ton miles (GTM)



### Promoting Fuel Conservation Practices

Our train crews and rail traffic controllers are continuously being schooled on best practices for fuel conservation. At the start of their careers with us, our new conductors, engineers, and rail traffic controllers are trained on fuel efficiency as part of our new hire programs through CN Campus. Fuel conservation practices include locomotive shutdowns in our yards, streamlined railcar handling, train pacing, coasting and braking strategies.

### Optimizing Yard Performance

Our innovative SmartYard optimization system makes traditional switching practices at our largest yards more flexible and efficient. The system uses the best sequence for processing cars and makes yard inventory adjustments to reduce dwell time, increase train speed and improve fuel efficiency.

**IN FOCUS:**

## Innovative Technologies Reducing Fuel Consumption and Emissions

**OBJECTIVE:**

We are committed to investing in new technology applications and providing training to improve our fuel efficiency and reduce our emissions.

Our new technology applications and enhanced analytical capabilities are helping improve the fuel efficiency of our freight operations:

- **RTBI** CN's Real Time Business Intelligence locomotive telemetry system provides real time information on locomotive and train performance. The information is being used to support fuel conservation, safety monitoring, locomotive health monitoring and incident investigation.
- **HPTA (Horse Power Tonnage Analyzer)** uses the data collected by the locomotive telemetry database to optimize a locomotive's horsepower to tonnage ratio.
- **Trip Optimizer** is an energy management system that processes real-time information on train characteristics, performance and terrain, and continuously computes the most efficient manner in which to handle the train.

**RESULTS:****Fuel Efficiency Improvement**

# 2.5%

improvement in fuel efficiency achieved in 2014

**Carbon Emissions Avoided**

# 142,012

tonnes of CO<sub>2</sub>e avoided in 2014

In 2014, trainees in our Locomotive Engineering Program began using a modernized training curriculum that included updated training materials and new simulation scenarios with these new technology applications. Students are evaluated on Rules, CN's Train Handling Policy, efficiency and fuel usage.

**ABOVE (FROM TOP):**

Trip Optimizer provides the potential for fuel saving through its cruise control features.

RTBI supplies real-time information on locomotive and train performance while optimizing fuel use by continuously scanning train operations.

Eric Kallin, Signalman at our modern training center in Homewood, Illinois, getting training on train handling and fuel efficiency.



# Reducing Our Non-Rail Carbon Footprint

Building on our industry leading rail fuel efficiency programs, we continue to extend the same efficiency mindset to our non-rail fleet including our intermodal equipment and trucking fleet, On Company Service (OCS) vehicles and our Great Lakes shipping vessels. Together, they represent 8% of our total carbon footprint.

## Our Initiatives

### Using Fuel Efficient Intermodal Equipment

We continue to use fuel efficient intermodal equipment including EcoTherm insulated containers and the Miller EnPack truck integrated hydraulic pumps and generators. We are also using Compressed Natural Gas (CNG) in shunt trucks at our Taschereau and Brampton Intermodal yards. CNG produces less particulate and nitrogen oxide emissions as well as 20% less GHG emissions.



**DRIVING CLEAN INNOVATION:** Switching from diesel to compressed natural gas shunt trucks in our Montreal and Brampton intermodal terminals has helped increase fuel efficiency by 17%, and reduce costs and our emissions.

In addition, we ensure containers are stacked to reduce gaps, which improves intermodal train aerodynamics and reduces fuel consumption and GHG emissions.

### Promoting Fuel Efficiency in Owner-Operated Trucks

CNTL is one of Canada's largest full-loading trucking companies made up of an owner-operated fleet. We promote a broad range of fuel efficient initiatives, including a preventive maintenance detection program, route optimization initiatives, and aerodynamic components and trucks. Truck drivers are also continuously trained on fuel efficient driving practices.

### Updating Our On Company Service (OCS) Vehicles

The OCS fleet consists of on-road and on-rail vehicles used to carry out day-to-day business operations, which we continue to update with more fuel efficient vehicles, including hybrids. We are also leveraging efficiency technologies such as GPS and training our employees to reduce idling and speeding.

### Maintaining Fuel Efficient Ship Engines

We operate an eight-vessel shipping fleet, consisting of four motor and four steam vessels. Our ships maintain fuel efficient engines and ship operators are trained on practices to reduce fuel consumption, including speed protocols and operating parameters.



#### STAKEHOLDERS ASK:

### Q. How is CN promoting more fuel efficient driver behaviours?

**A.** We believe that a big factor in fuel economy is the driver behind the wheel. As part of our EcoConnexions program, we introduced a training program for all drivers on fuel efficient driving practices such as tractor maintenance, route optimization and gear and wheel selection, speed control and idling and fuel levels. We also provide regular scorecards to drivers on their progress and give out annual awards to the most fuel efficient drivers.

Our CNTL truck drivers are finding that more aerodynamic vehicles coupled with decelerated speeds are making a difference.

#### MARTYN PETERSON

Manager, Truck Operations



**ABOVE (FROM LEFT):**  
Martyn Peterson  
Manager, Truck Operations  
Mario Descheneaux  
Supervisor, Truck Operations  
Rick Smollet  
Owner-Operator Truck Driver

## Improving Fuel Efficiency Through Aerodynamic Specifications and Driver Training

Truck Operations Manager and EcoChampion Martyn Peterson introduced aerodynamic specifications for CNTL new trucks about six years ago as a means of reducing fuel consumption, making CN one of the first to encourage their adoption. Coupled with a training program for drivers, led by Mario Descheneaux, Supervisor of Truck Operations in Mississauga, the team has been delivering results.

Rick Smollet, one of our owner-operators, purchased a new, more aerodynamic vehicle and saw immediate improvements in fuel efficiency. He is also a veteran in fuel-saving driving techniques: "I control my speed, keep a steady pace and maintain good distance from the next vehicle."

Our CNTL truck drivers are proving that more aerodynamic vehicles and fuel efficient driving techniques are making a difference. We've recorded about a 2% decrease in fuel consumption year-over-year.



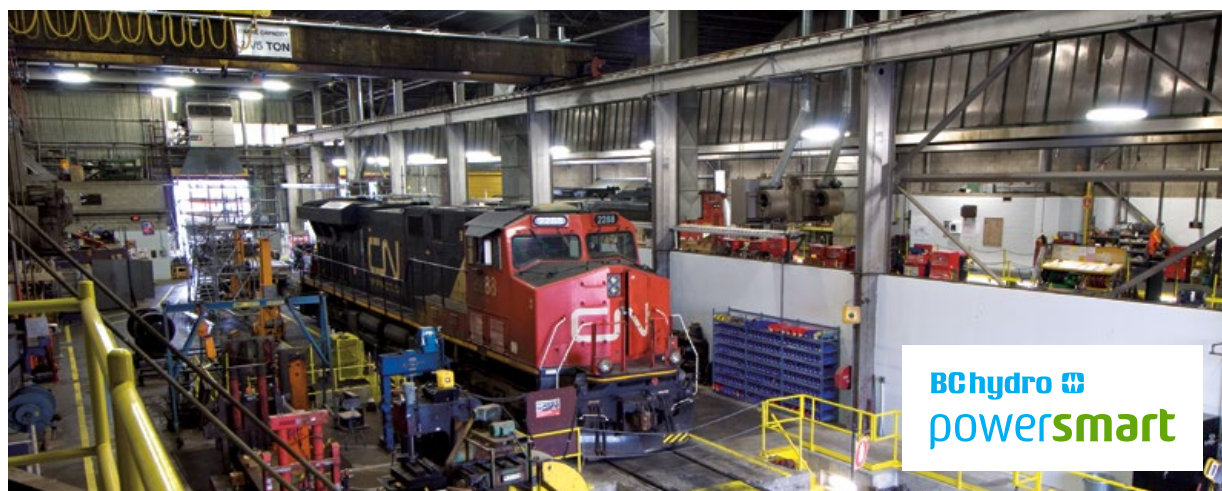
## Improving Efficiency at Our Buildings and Yards

Our buildings and yards account for approximately 7% of our GHG emissions, comprising electricity, natural gas and miscellaneous fuel consumption. We are committed to improving the use of energy in our existing buildings and yards, while integrating more sustainable designs into new buildings.

### Our Initiatives

#### Monitoring and Measuring Energy Consumption

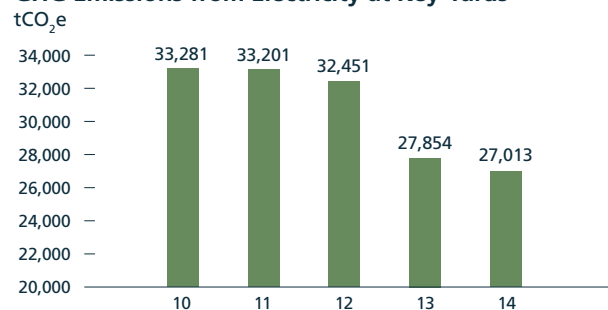
In 2014, we strengthened our management systems that measure and monitor how energy is consumed across North America. Building on our energy monitoring system, we launched a new Energy Operation (EO) system to capture energy data from smart meters, which we installed in major buildings, yards, and on key equipment at CN facilities.



**THORNTON YARD ENERGY INITIATIVES:** Our energy partnership with B.C. Hydro, coupled with energy conservation awareness as a result of EcoConnexions, has resulted in a 20 percent reduction in energy use in Thornton Yard in Surrey, B.C. Our investments into new lighting systems and equipment upgrades are made possible by our \$5-million CN EcoFund, which reinvests the significant cost savings generated by EcoChampion initiatives into new capital projects that support energy conservation and waste reduction.

**19%** reduction since 2010,  
exceeding our target of 15%

#### GHG Emissions from Electricity at Key Yards



The data includes how energy is being consumed in administrative buildings, at car shops and locomotive repair centres, as well as how it is consumed by energy intensive equipment such as air compressors, lighting fixtures, and boilers. System users can easily track their energy use, compare to other CN locations, set goals, get early detection of poor energy performance and make better energy decisions. The EO system is helping groups in our major yards across CN monitor and reduce their energy consumption and GHG emissions.

#### Upgrading Our Buildings and Yards

Over the past few years, we have continued to upgrade our buildings and yards with more energy efficient products, including boilers, air compressors, HVAC systems and lighting. For example, LED lighting retrofits have been installed at some of our largest yards, including Symington Locomotive Repair Centre. The Calgary Logistics Terminal installed an innovation that enables crews on trains to turn on yard lights from their locomotive cab, resulting in further energy savings.