Statistics show that we are living in the safest, most productive era in the history of America’s freight rail industry. Robust investment across the network has dramatically improved nearly every aspect of railroad operations. Between 2000 and 2021, the train accident rate is down 33% and a single train can move one ton of freight nearly 500 miles on a single gallon of fuel, on average.

America’s freight railroads are on the cusp of the next great era of safety and efficiency improvement. From smart sensors to artificial intelligence, railroads are harnessing the power and promise of technology to drive even greater improvement in the years ahead. Railroads are deploying technology across the network to make meaningful progress on safety challenges; meet the evolving needs of our customers; reduce the industry’s carbon footprint; empower rail employees and address important community concerns. Moving forward, greater application of rail technology — enabled by pro-innovation regulations — will help the industry get closer to reaching its ultimate goal of zero accidents. Technologies supporting regulations will also drive greater economic prosperity across our nation.

**Delivering an Accident-Free Future**

Focusing on the leading causes of accidents, freight rail employees use technology to make informed decisions and address issues proactively before accidents occur. Many of these technologies are developed and tested at the Transportation Technology Center, Inc. (TTCI), the industry’s world-renowned rail research organization in Pueblo, Colorado.

- **Human Error:** Life-saving technology called Positive Train Control (PTC) has been fully deployed on lines that carry passengers and high volumes of hazardous materials. PTC monitors train location, speed, track signals, and many other inputs, to prevent certain train-to-train collisions and derailments caused by human error.

- **Track & Infrastructure:** With a nearly 140,000-mile outdoor network of tracks, bridges, tunnels and more, railroads apply technology to monitor network health in real-time. Specialized inspection technology integrated into locomotives and rail cars scans track as trains move at speed to identify defects like cracks deep within the rails. These tools enable railroads to inspect their infrastructure with greater frequency, accuracy and reliability than ever before.

- **Trains & Equipment:** With hundreds of thousands of rail cars operating across the country each day, railroads use technology to closely monitor and plan for equipment maintenance. New machine visioning technology uses specialized cameras and data analytics to inspect trains as they pass, reducing inspection times to mere seconds. Using advanced data analytics, Big Data from this and other technologies serves as the foundation for future initiatives.

**Key Takeaway**

Freight railroads use technology to keep employees, communities, infrastructure and equipment safe while improving customer service and decreasing the industry’s carbon footprint.
Meeting Customer Needs

America’s freight railroads use the latest technology to move freight more efficiently than ever before. Their investments are designed to increase capacity, improve reliability and deliver unparalleled customer service for rail customers. With freight demand expected to increase 30% by 2040, greater application of rail technology will ensure U.S. businesses continue to have the cost-effective transportation solution that makes them competitive in today’s tough global economy.

- **Growing Capacity**: The latest rail logistics planning software uses Big Data and artificial intelligence to predict patterns in train traffic and develop routing models to increase railroad velocity, capacity and efficiency.

- **Improving Reliability**: Intermodal is now the biggest rail traffic segment. Railroads work closely with intermodal customers to improve reliability. Data analytics models can now predict the ideal time to perform maintenance months in advance, enabling railroads to make repairs well before an equipment breakdown impacts network fluidity.

- **Customer Service**: Railroads use technology to give their customers greater insight into rail operations. This helps rail customers better manage their own operations and inventory. Many railroads have developed specialized tools — from Application Programming Interfaces integrated directly into customer platforms to shipment tracking tools — that provide greater transparency for everything from the location of their products on the rail network to rail car availability and ordering.

Protecting the Environment

Railroads are the most fuel-efficient way to move freight over land, so moving more freight by rail means fewer greenhouse gas emissions. **Railroads are taking steps in every aspect of their operations to further reduce emissions**, increase fuel efficiency and preserve the natural environment.

- **Conserving Fuel**: Today’s locomotives contain hundreds of sensors and state-of-the-art fuel management technology that monitor performance and calculate the most fuel-efficient speed for a train along a given route.

- **Reducing Emissions**: In some rail yards, zero-emission electric cranes are used to transfer goods between ships, trucks and trains, and yard locomotives are equipped with stop-start systems to shut down a locomotive when it is not in use.

- **Relieving Highway Congestion**: A single train can carry the load of hundreds of trucks, effectively removing them from our nation’s highways. Thanks to improved freight car design and other efforts, in 2021, the average freight train carried 4,082 tons, up from 2,923 tons in 2000.
Safeguarding Employees & Communities

Freight rail’s commitment to the health and well-being of its employees and communities is best demonstrated by the unique safety culture that defines every aspect of employee relations and community engagement. From training to information sharing and pandemic response, technology plays an increasingly important role in this mission.

- **Keeping Employees Safe:** The rail industry is one of America’s safest places to work with lower employee injury rates than most other industries. Advanced training centers with simulators and virtual reality enable employees to practice real-life skills in a safe, rigorous and controlled environment, while innovations like remote control locomotives and high-definition cameras allow employees to perform their jobs effectively from a distance where possible, keeping them out of harm’s way. Railroads developed mobile applications to enable locomotive engineers to adhere to COVID-19 social distancing protocols.

- **Information Sharing:** Technology has made it easier than ever to share information and resources with community leaders in the rare event of a rail incident. The AskRail mobile app — a collaborative effort among the emergency response community and America’s freight railroads — provides tens of thousands of the nation’s first responders with immediate access to accurate, timely data about what type of hazardous materials a rail car is carrying so they can make an informed decision about how to respond in the event of a rail emergency.

- **First Responder Training:** For decades, railroads have worked closely with the nation’s first responder community to educate and train it on rail accident response. When business travel was put on hold due to the pandemic, the Security and Emergency Response Training Center — operated by TTCI — launched an online training program to ensure the nation’s first responders have uninterrupted access to critical hazmat response training during this challenging time.

- **Enhancing Motorist and Pedestrian Safety:** To help keep the public safe near tracks, railroads have worked with federal regulators and private technology companies to develop technological solutions to improve safety around railroad tracks and rights of way. For example, railroads have partnered with Waze to develop a safety feature that alerts app users to upcoming grade crossings. As autonomous vehicle technology continues to be developed, railroads have called on the U.S. Department of Transportation to ensure that these vehicles recognize and react properly to warning devices at grade crossings.
**ADVANCED FUEL MANAGEMENT SYSTEMS**
assess track grade, train weight, wind speed and more, allowing our locomotives to move one ton of freight 400+ miles on a single gallon of fuel — 3-4x more efficient than trucks.

**POSITIVE TRAIN CONTROL**
continuously analyzes the hundreds of variables required to safely stop a train at any given time, counteracting human error.

**MODERN TIER 4 LOCOMOTIVES**
are outfitted with hundreds of sensors that generate thousands of performance readings per minute to maximize efficiency.

**SMART SENSORS**
positioned along the track identify worn components on passing trains in real-time and amass a wealth of data for advanced analysis.

**AUTOMATED INSPECTION EQUIPMENT**
monitors track integrity including curvature, alignment, grade, ballast and more.