Safer, Faster, Cleaner-
The Future of Freight Mobility

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OCTOBER 19, 2021
This is BNSF
About BNSF Railway

• A Berkshire Hathaway company
• ~34,000 employees
• ~8,000 locomotives
• Operates an average of 1,200 trains/day
• 32,500 route miles in 28 states and three Canadian provinces
• 13,000 bridges and 89 tunnels
• Serves +40 ports
• 26 intermodal facilities
Positive Train Control Enhances Safety

BNSF’s PTC System

GPS

Locomotive

Hand Throw Switch

Wayside Signal Switch

Network Operating Center

Base Station

Base Station
Leveraging PTC Technology for Efficiency

Installation of mandated PTC infrastructure completed in Dec. 2017

- 92% of freight volume is moving on PTC routes
- 14,500+ route miles of PTC infrastructure have been installed
Autonomous Track Geometry Cars

Purpose:

• Reduce risk to employees
• Drive inspection efforts on track where they are most needed
• Increase the availability of network and track to customers by reducing number of inspection-related work windows
Increased Track Inspection Miles Drive Improvements

Since 2012, BNSF has reduced the number of track defects by 91%

Source: BNSF internal data for main tracks and sidings.
Equipment Detection Technology

- More than 4,000 trackside detectors
- Hot Box Detector (HBD)
- Wheel Load Impact Detector (WILD)
- Trackside Acoustical Detector (TADS)
- Sonic Cracked Wheel/Axle Detector (CWAD)
- Machine Vision Systems
- Magnetic Particle Inspection
- Warm Bearing Detection System (WBDS)
- Hot Wheel Detectors (HWD)
- Truck Performance Detectors (TPD)
Moving from Detection to Prediction

- **Acoustic Bearing Detector (ABD)** – acoustic systems used to evaluate sounds generated by specific bearing component defects

- **Hot Box Detector (HBD)** – evaluates bearing temperature history for statistical outliers; brake issues, burned off journals

- **Cracked Wheel/Axle Detector (CWAD)** – Rail mounted sensors capable of detecting the difference between tones generated by normal vs. flawed wheels and axles
Efficiency
Shifting to Rail Cuts Land Freight Carbon by Roughly Two-Thirds

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<tr>
<th>Reducing Highway Congestion</th>
<th>Increasing Fuel Efficiency</th>
<th>Generating Fewer Emissions</th>
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<td>One BNSF intermodal train removes several hundred long-haul trucks from our nation’s highways</td>
<td>Rail is over 3 times more fuel efficient than long-haul trucks</td>
<td>BNSF customers reduce GHG emissions by over 34 million metric tons each year vs. highway</td>
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Results: Significant carbon avoidance and reduction of supply chain emissions for rail customers
BNSF continues to invest in sustainable technologies:

- Battery-Electric Locomotives
- Battery-Electric Hostlers, Forklifts & Drayage Trucks
- Idle Control
- Electric Wide-Span Cranes
- Automated Gates at Intermodal Facilities
- More Fuel-Efficient Tier 4 Locomotives
Battery Electric Locomotive

Op Cab
- No Change

Aux Cab
- New Inverter Arrangement
- 480VAC Bus

Blower Cab
- Traction Blower
- Aux Blower
- HV/LV cabinets
- Batt Cab Door

Battery Cab
- Climate controlled
- 20 Racks
- 25 Modules per rack

Sand Cab
- Batt Cab Door
- Sand Box’s
- Hand Brake

Repurposed Fuel Tank
- A-side: Compressed Air components
- B-side: Wayside Charging components

Eliminated
- Engine
- Alternator
- Cooling System

Source: Wabtec
Carbon Reduction Programs and Results

Carbon Reduction Results and Target
- Emissions: Cut carbon intensity in half over last 40 yrs.
- Target: In March, committed to set a Science-Based Carbon Target

Carbon Reduction Program
- Fuel Efficiency Program leveraging technology, operations
- Expanding use of lower carbon intensity renewable diesel
- Developing zero emission equipment for intermodal railyards
- Piloted a battery-electric locomotive

Battery-electric yard trucks
Great Northern Corridor
GNCC Mission: Promote a premier multistate / multimodal corridor by acting collectively to promote public policy, research, and multimodal infrastructure development that protects and expands commerce and enhances safety on the corridor.