Downer

ZTR™

Sustainable Rail Freight Solutions

Panelists

Ashley Thompson
General Manager
BD Freight
Downer Group

Amarjit Soora
Director
Product Management
ZTR

Lucas Pul
Director
Director of Technology
ZTR

Garrett Riley
Director
Regional Account, US
ZTR

Railway Modernization Experts

SINCE 1987

- Leaders in locomotive modernizations, rail digitalization and remote monitoring.
- Decades designing control systems for rail applications.
- Personalized and proven railway solutions for 36+ years.
- Sophisticated and innovative engineering and design expertise.
- Software Development focusing on Value Added Services
- Global industry footprint.

Australia’s #1 rail & transit systems provider

Downer Rail & Transit Systems (RTS)

270+
engineers

150+
years rail experience

3,000+
Rollingstock units overhauled*

3,000+
Rollingstock units built*

15+ sites
& facilities operated

2,000+
Rollingstock units maintained*

1,700+
team members

3,600km
network length

Downer’s recent flagship projects

Design and develop world’s most energy efficient battery electric locomotive with Fortescue Zero.

Design, build and maintain **70 seven-car High Capacity Metro Trains** in Melbourne.

Project vaue: $2.4B AUD

Design, build and maintain **65 six-car passenger trains as part of Queensland Train Manufacturing Program.**

* including contracted work

Downer and ZTR partnership

Downer has exclusivity for ANZ

Perfect partnership for us to help **you** see immediate emissions results.

As Australia's leading provider of rail and transit systems, Downer offers engineering and operational support.

We can undertake design modifications, installation and integration on your locomotives for the ZTR product range, if required.

Support through one of our sites within our established footprint in Australia, or through yours.

What we offer

- Immediate emissions reductions
- Modifications, installation of integration
- Your site or ours
- Support

Downer ZTR™

Products

ZTR Control Products

HISTORY

1990s	2000s	2010s	2020s
Introduction of Adhesion Control Systems, AESS	Introduction of Intuitive Diagnostics & Remote Monitoring	Advanced Control Systems, Diagnostic, Always Connected	Super Capacitor, Battery Management, Hybrid Technology

SmartStart

Automatic Engine Stop-Start (AESS)

Challenges

Manual Engine Management

Human errors, variability in execution, and lack of standardized protocols

Complex Ecosystem and Diverse Fleet

Different locomotive types, models, ages, and manufacturers require tailored solutions

Uncertain Quantification of Benefits

Absence of robust monitoring systems that can track and analyze data in real-time

Resistance to Change

Convincing stakeholders of the benefits and viability

Inefficient Emission Reduction

Inconsistencies in timing and execution

AESS Technology

OVERVIEW

An Automatic Engine Stop-Start (AESS) system operates by intelligently managing the engine's shutdown and startup processes

An AESS system makes real-time decisions based on predefined criteria

Sensors monitor crucial parameters and operational status

AESS systems enhance operational efficiency while minimizing human intervention and error

SmartStart AESS

The Most Trusted AESS

30+
Years of Global History

10K+
SmartStart AESS Installed

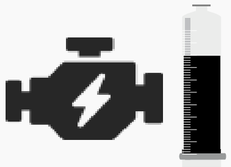
SmartStart AESS

How it Works

Brake Pipe Pressure
(leaks in the air system)

Ambient Temperature

Engine Temperature



Battery Health

SmartStart Health
Status

Operator Console

How it Works

Parameter	Auto Shutdown Value	Auto Restart Value
Ambient Temp (F)	Above: 32	Below: 28
Engine Water Temp (F)	Above: 120	Below: 100
Battery Charging Current (A)	Below: 20	N/A
Battery Voltage (V)	Above: 63	Below: 63
Runtime after Loading (Mins)	Above: 15	N/A
Brake Cylinder Pressure (psi)	Above: 22	Below: 18.5
Reverser Position	Centered	FOR/RER
Enable Status	Green (Enabled)	Green (Enabled)

SmartStart AESS

Features

Fully Automated Operation

By eliminating the need for operator intervention, SmartStart ensures consistent and optimal engine shutdown and startup processes

Optimal Emission Reduction

Leveraging its advanced algorithms and real-time monitoring capabilities, SmartStart achieves optimal emission reduction

Universal Applicability

Regardless of manufacturer, model, age, or usage, SmartStart can be seamlessly integrated into a wide range of locomotives.

Benefits

Accurate & Up-to-date Data

Compliance & Reporting

Flexible, Expandable Technology

Future-proof Expansion

Load Shedding

Battery Saver

Automated Notifications

SmartStart AESS Remote Monitoring

Condition Based Maintenance

SmartStart's remote monitoring enables improved ROI by providing insights into key factors like potential fuel savings through detecting compressed air system leaks, monitoring operator behavior (such as reverser use or engine shutdown practices), and identifying when battery support or KickStart supplementation may be beneficial.

GPS Location & Geofencing

The technology enables real-time tracking and monitoring of locomotives.

Fleet Reports

Provide performance insights for analytics and planning.

Automated Alarm Notification

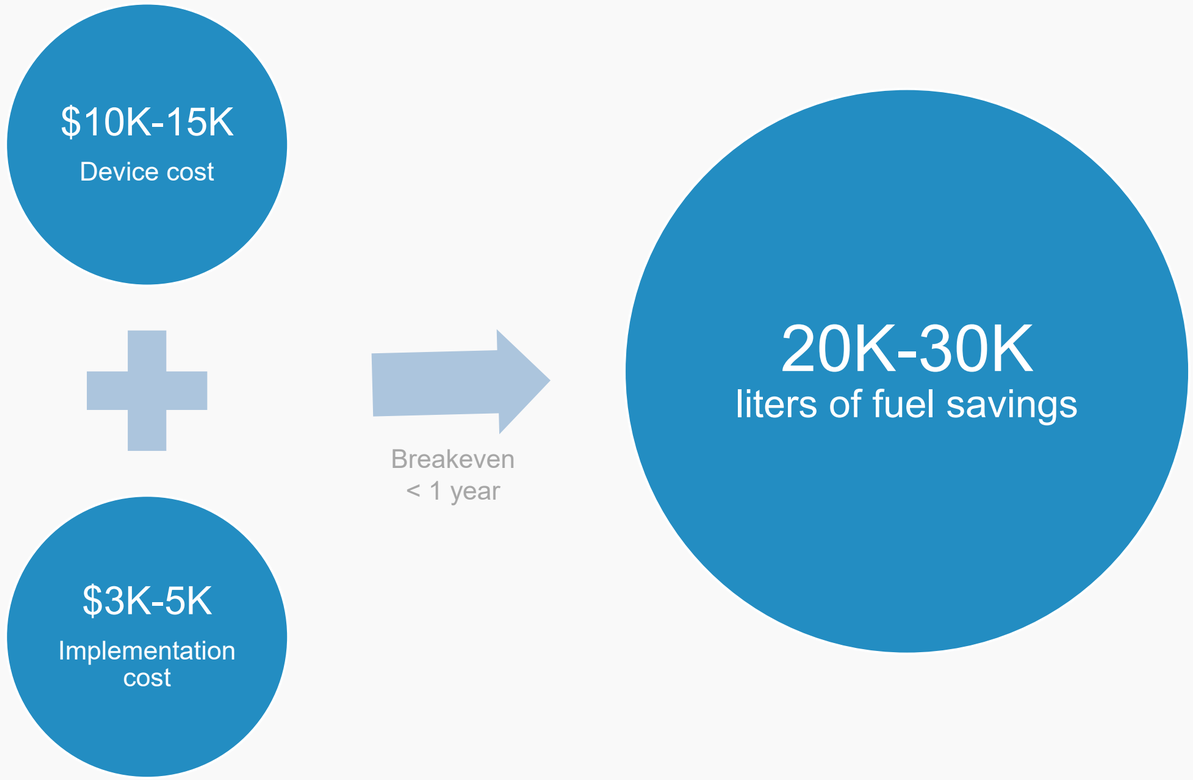
Get Realtime alerts for locomotive events

Operational Insights

Uncover patterns, trends and opportunities to drive areas of improvement.

SmartStart AESS

Return on Investment



KickStart

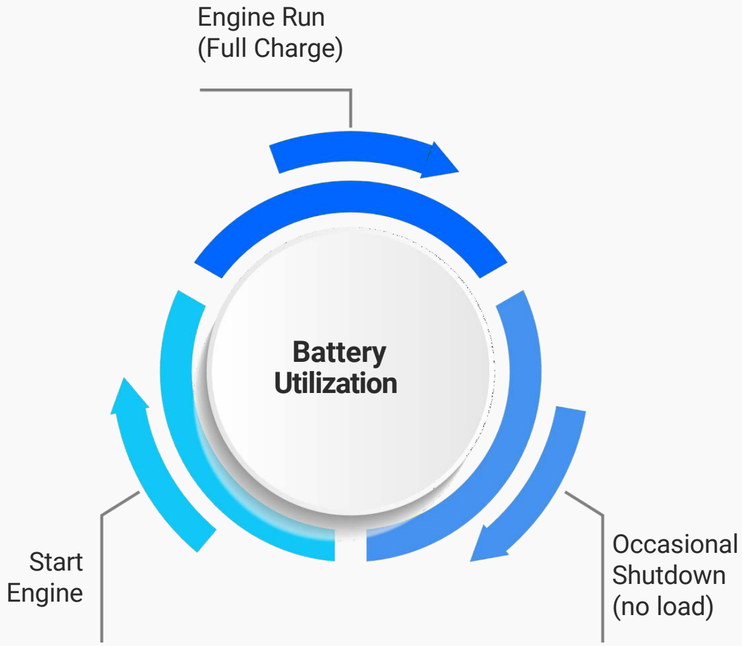
Locomotive Starting Assist

Battery Health

Decades Ago

Starting lead acid batteries were used solely for starting purposes (as intended):

- Decades ago: Lead Acid Batteries lived a happy life and utilized as intended for use
- Charging: Healthy – engines ran a long time
- Start/Stop: Infrequent – long engine idle times
- Hotel Loads: No electronics to power

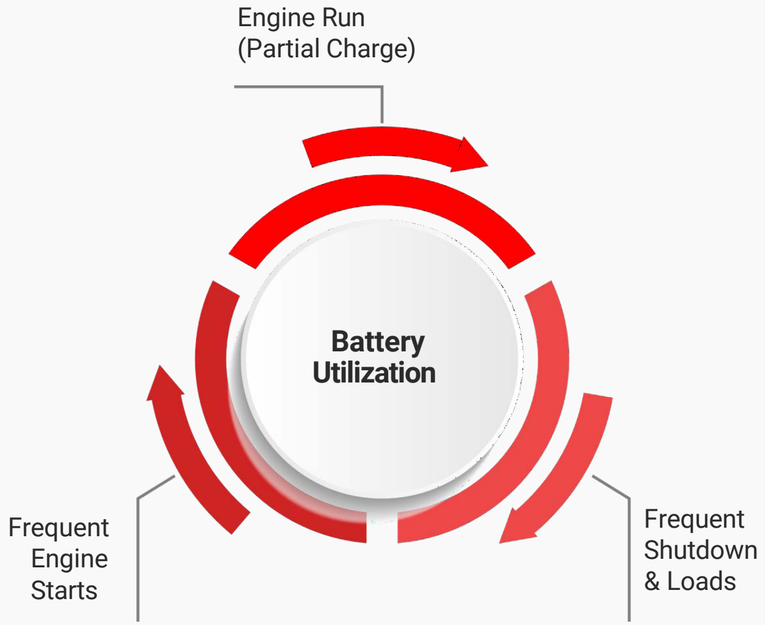


Battery Health

Now – Legislations, Drive for Efficiencies

Today batteries are no longer meeting the required needs of a locomotive:

- Charging: Inadequate – less engine idle time
- Start/Stop: High – more taxing on batteries
- Hotel Loads: High – not strength of lead acid batteries



Supercapacitor Starting Assist

Technology Overview

Supercapacitor starting assist technology is an excellent means by which to address these issues and at reasonable cost and effort.

- Supercapacitors have higher power density than batteries
- They recharge quickly and discharge energy at a rate much faster than batteries, resulting in reliable engine starting performance
- Supercapacitors also have consistent performance across a wide temperature, and, unlike lead acid batteries, they are not impacted at colder temperatures

KickStart Starting Assist

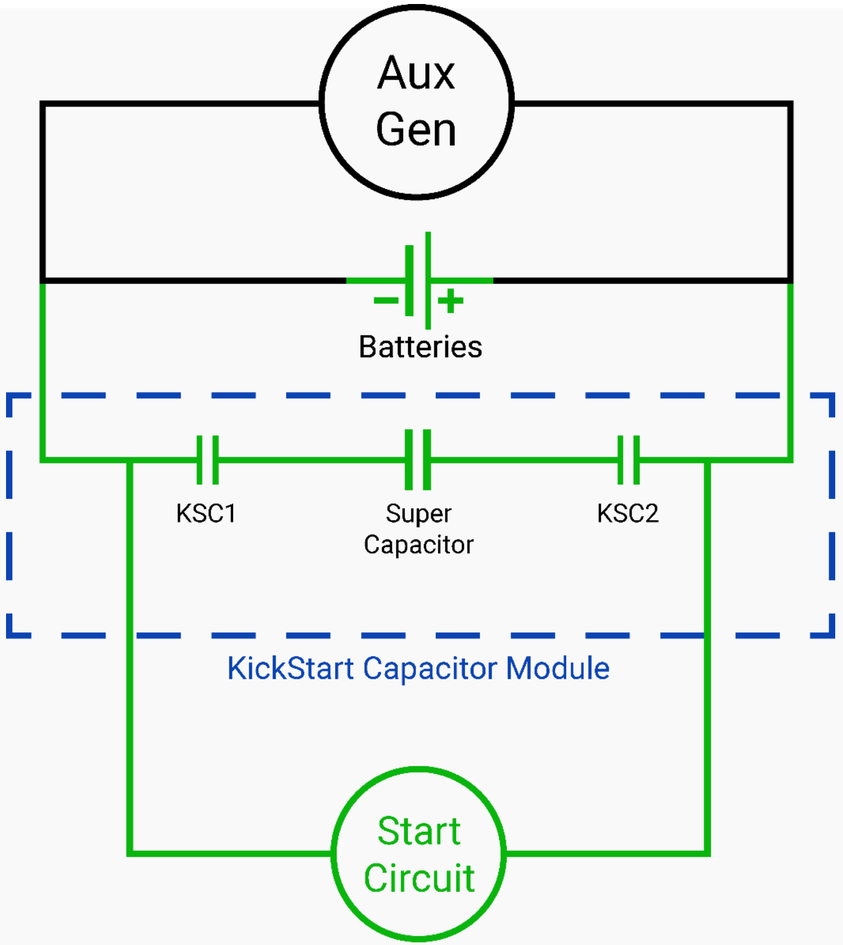
How it Works

Supercapacitor starting assist technology works by utilizing the stored energy in supercapacitors to provide a burst of power during engine cranking. Here's a simplified overview of the process:

1. When the locomotive engine is running the supercapacitor charges from the auxiliary generator

2. When the engine is off, the supercapacitor is isolated from the battery system and maintains it’s charge

3. During the engine crank cycle, the supercapacitor connects with the battery to the starting circuit, providing the peak current (torque) to successfully start the engine

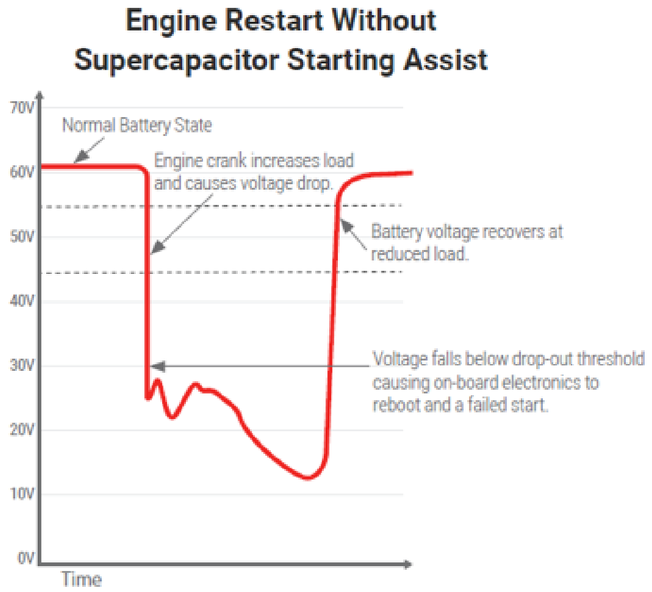


KickStart Starting Assist

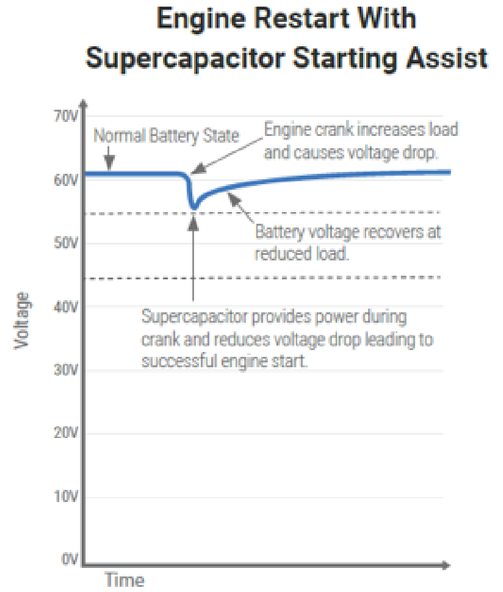
Improving Locomotive Availability

Batteries are one of the leading causes for engine starting problems. Once the voltage drops below a threshold, the onboard electronics will cycle and the cranking will cease causing a dead-won't start.

With a supercapacitor starting assist solution, the initial kick provided results in a higher engine rotating velocity, which means less voltage sag, and faster and successful start



Showing a failed start due to the engine crank causing voltage to drop below 55 volt threshold.



Showing a successful engine start using a supercapacitor starting assist.

KickStart Starting Assist

Benefits

Improved Locomotive Availability

The technology minimizes dead-won't-start (DWS) events, leading to increased availability and reduced maintenance costs.

Fuel Consumption Reduction

Studies show that the technology can improve AESS performance, leading to significant fuel savings, resulting in cost reductions, improved profitability and sustainability.

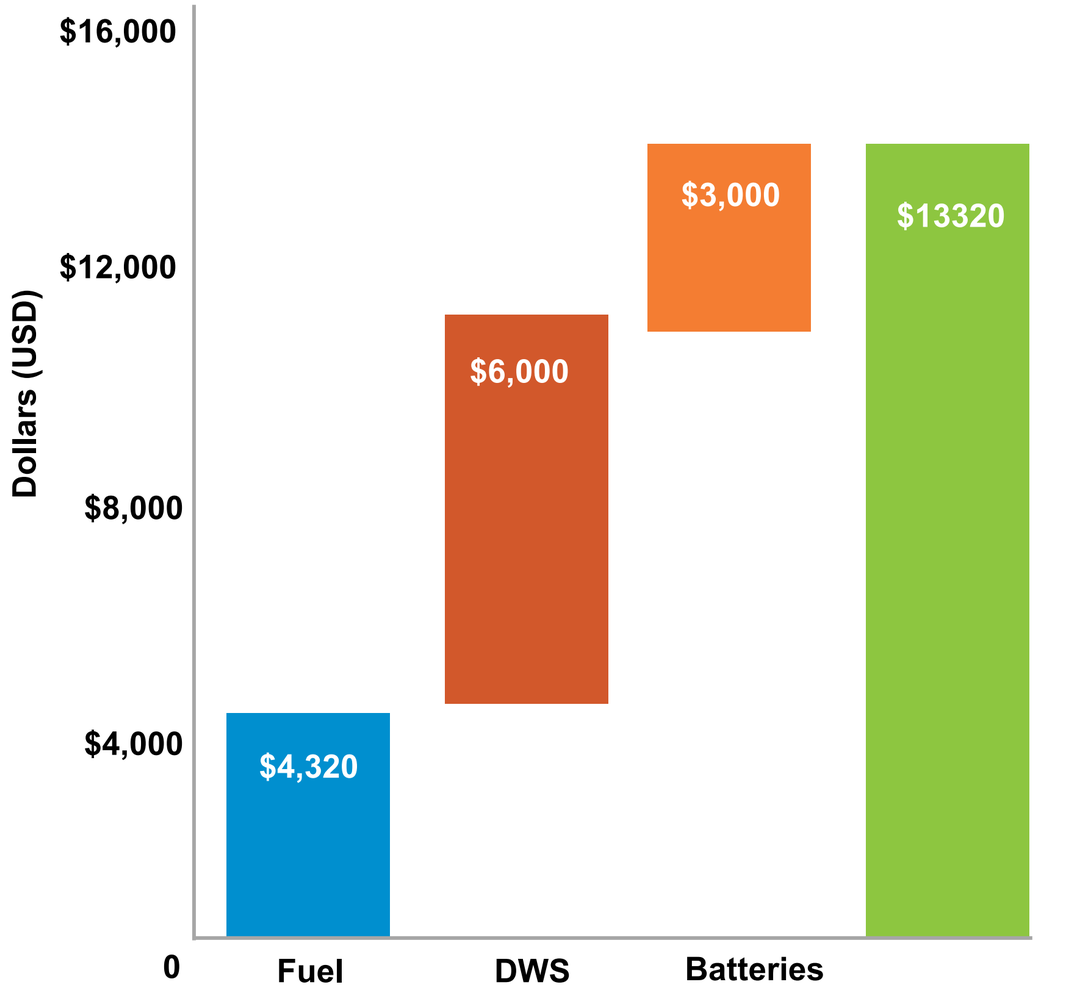
Extended Battery Life

The typical battery life of a lead acid battery in a locomotive application with an AESS can be doubled to an expected 4-5 years with KickStart.

KickStart – Return on Investment (ROI – 1 year)

Calculating the return on investment is essential to understand the financial benefits of implementing supercapacitor starting assist technology. An analysis reveals the annual savings per locomotive, considering fuel savings, preventing costly in service failures, and extending battery life. The total average annual savings associated per locomotive equipped with a supercapacitor starting assist solution like KickStart is about $13,000-$14,000/year comprised of:

- $4,320/year for fuel reduction,
- $6,000/year in avoided costs for preventing dead won't starts,
- $3,000/year in costs avoided by extending battery life

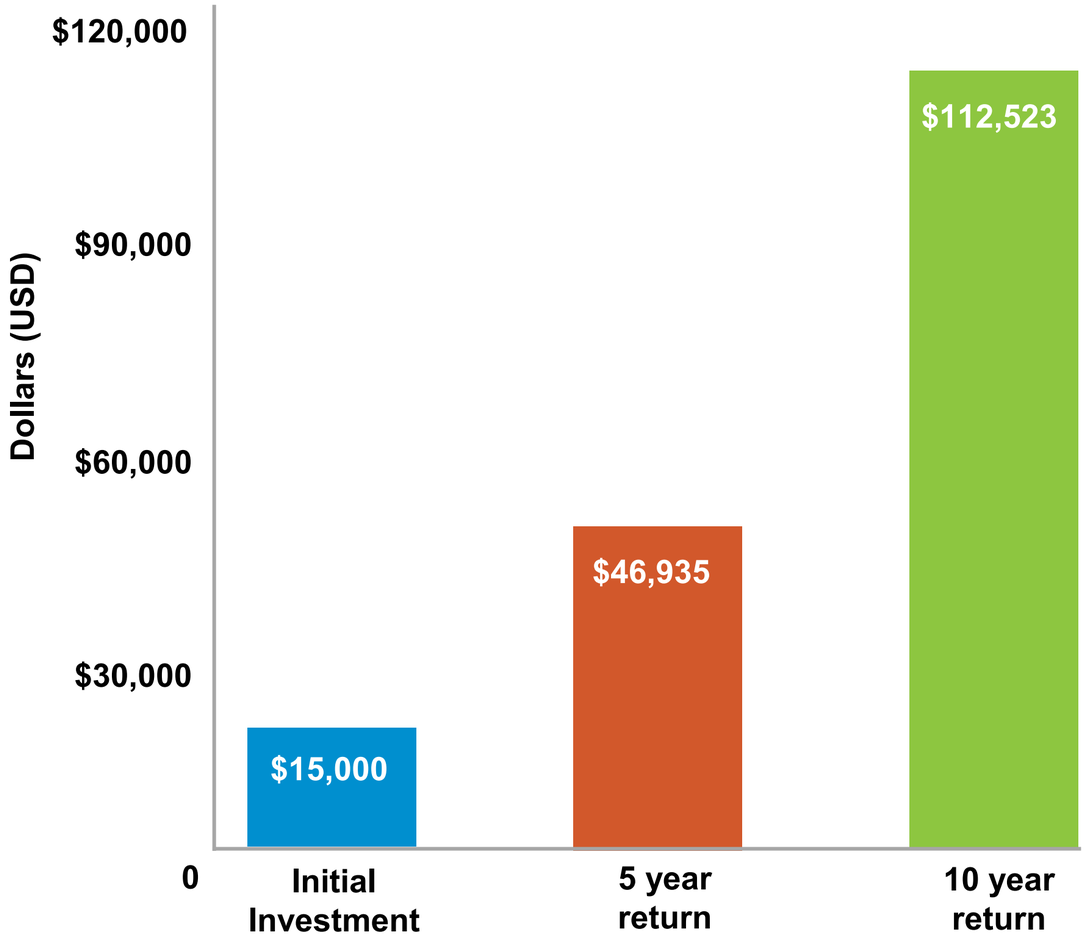


Return on Investment (ROI – 10 years)

The durability and longevity of supercapacitor systems ensure long-term savings over a 10-year period, resulting in a favorable payback period.

The implementation of supercapacitor starting assist technology for solutions like KickStart is expected to generate more than $112,000 in savings over 10 years when the supercapacitor asset life is 20 years. Consider the low $15,000 investment, the payback period is just about one year.

Assuming reductions in battery replacements from once every two years to once every 4 years.



NEXSYS

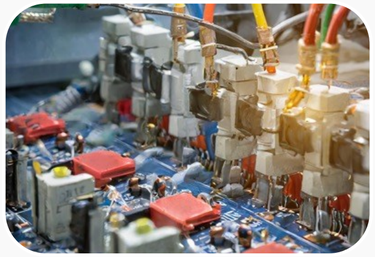
Locomotive Control System

Locomotive Control Systems

Challenges

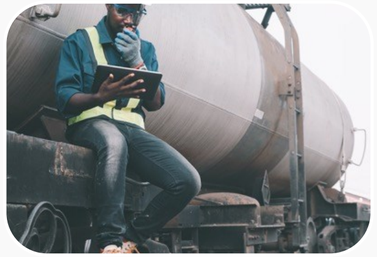
Outdated Technology

Maintenance and Reliability



Lack of Integration and Compatibility

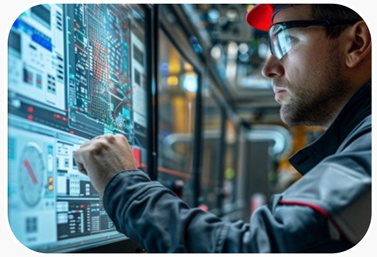
Inefficiencies in Fuel Consumption and Performance



Regulatory Compliance

Limited Data Analytics and Insights

Limited Remote Monitoring and Diagnostics



Lack of Predictive Maintenance

Locomotive Control Systems

Advanced Requirements

- Seamless Integration and Interoperability
- Enhanced Performance and Efficiency
- Superior Reliability and Less Maintenance
- Improved Safety and Compliance
- Real-time Data Analytics and Insights
- Scalability and Flexibility
- Remote Monitoring
- Cost-effective Investment and ROI

NEXSYS Locomotive Control System

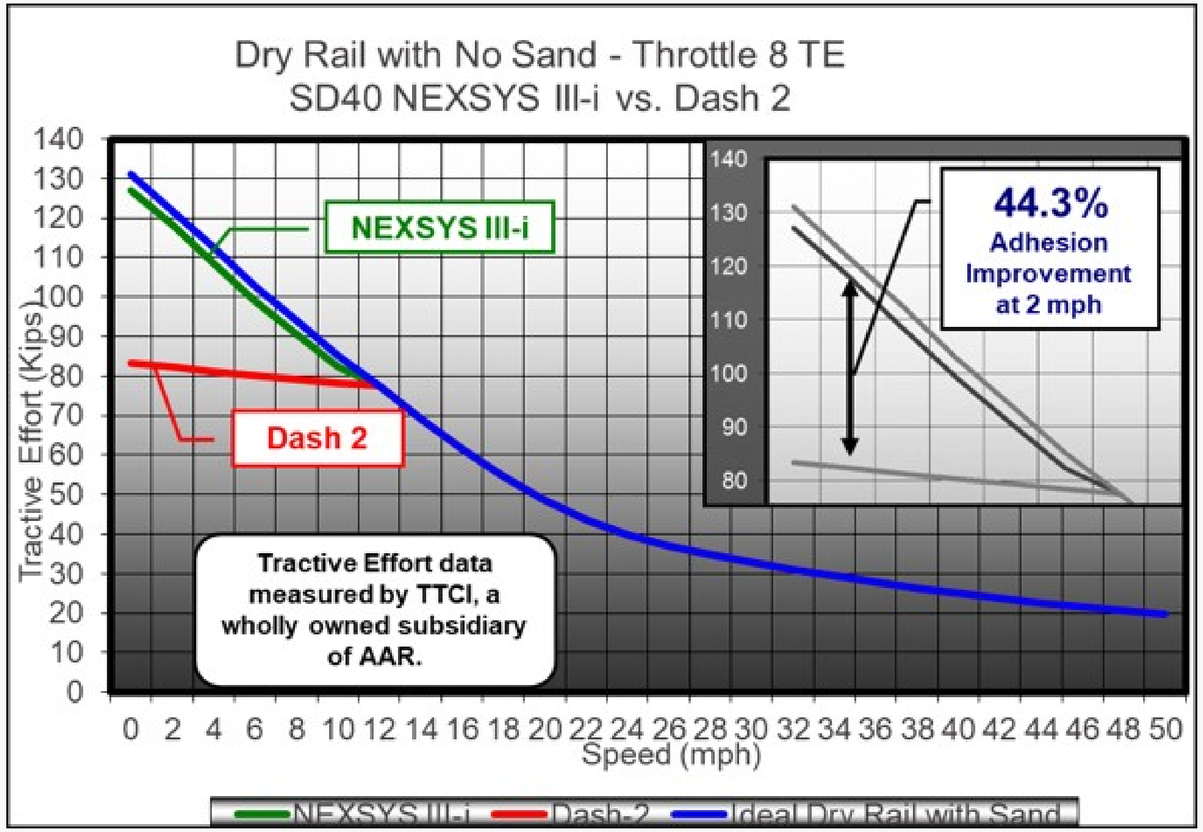
Features & Benefits

- Propulsion Efficiency
- Reliability and Availability
- Emissions and Cost Reduction
- Onboard Diagnostics
- Integrated Locomotive Display
- Remote Monitoring
- Excellent ROI

NEXSYS Locomotive Control System

Propulsion Efficiency – Dry Rail

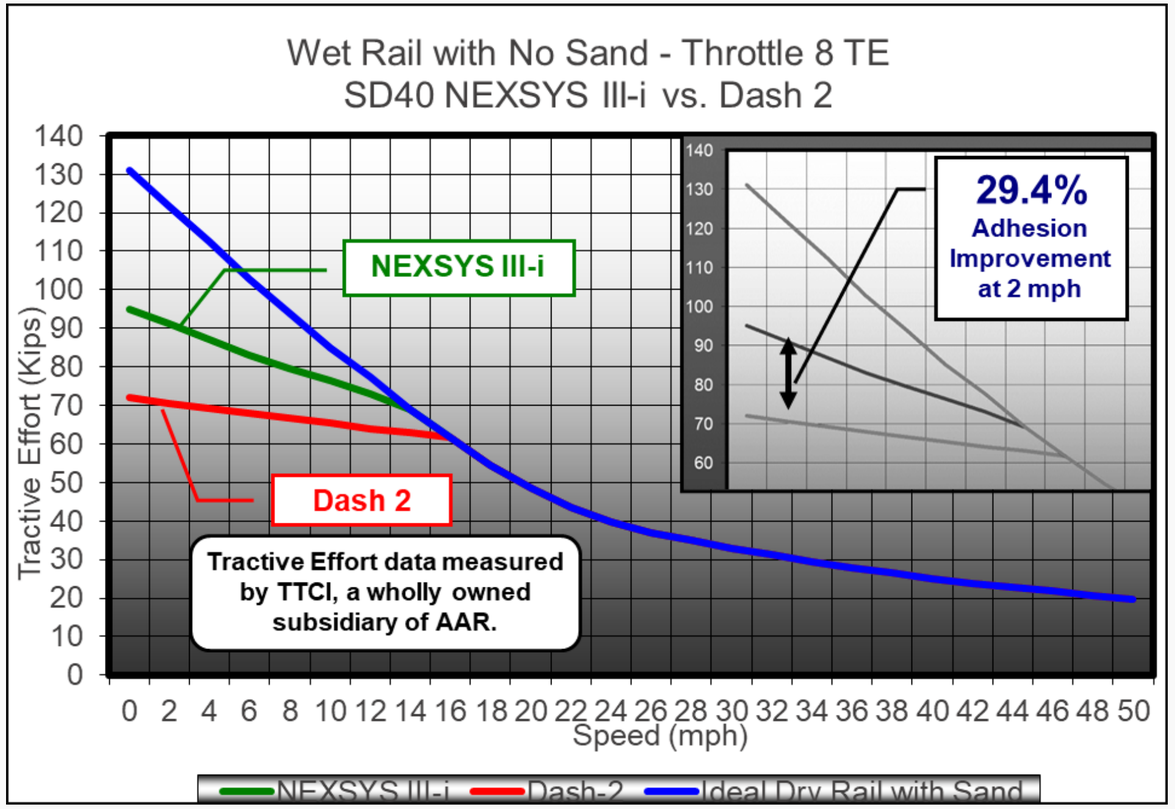
- Adhesion Control
- Locomotive Model: SD40-2
- Control System: Dash 2 vs NEXSYS IIIi
- Dry rail (no sand) → **44% increase** at 2MPH



NEXSYS Locomotive Control System

Propulsion Efficiency – Wet Rail

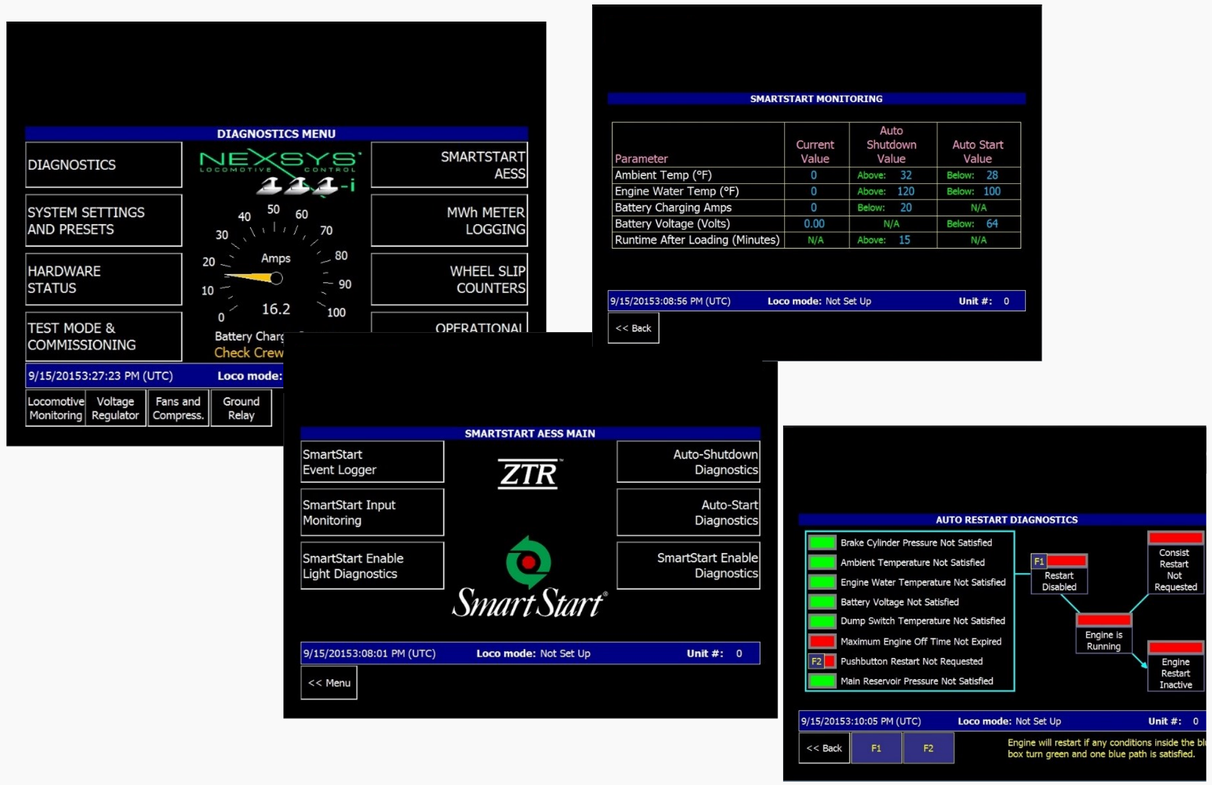
- Adhesion Control
- Locomotive Model: SD40-2
- Control System: Dash 2 vs NEXSYS IIIi
- Wet rail (no sand) → **29% increase** at 2MPH



NEXSYS Locomotive Control System

Onboard Diagnostics

- Main locomotive parameters
- System health status
- Output-test and advanced diagnostics
- Pre-departure test
- Automated Contactor Test, Load Test
- Troubleshooting information
- Reports (detailed fuel savings, duty cycle, event logger etc.)
- Crew messages



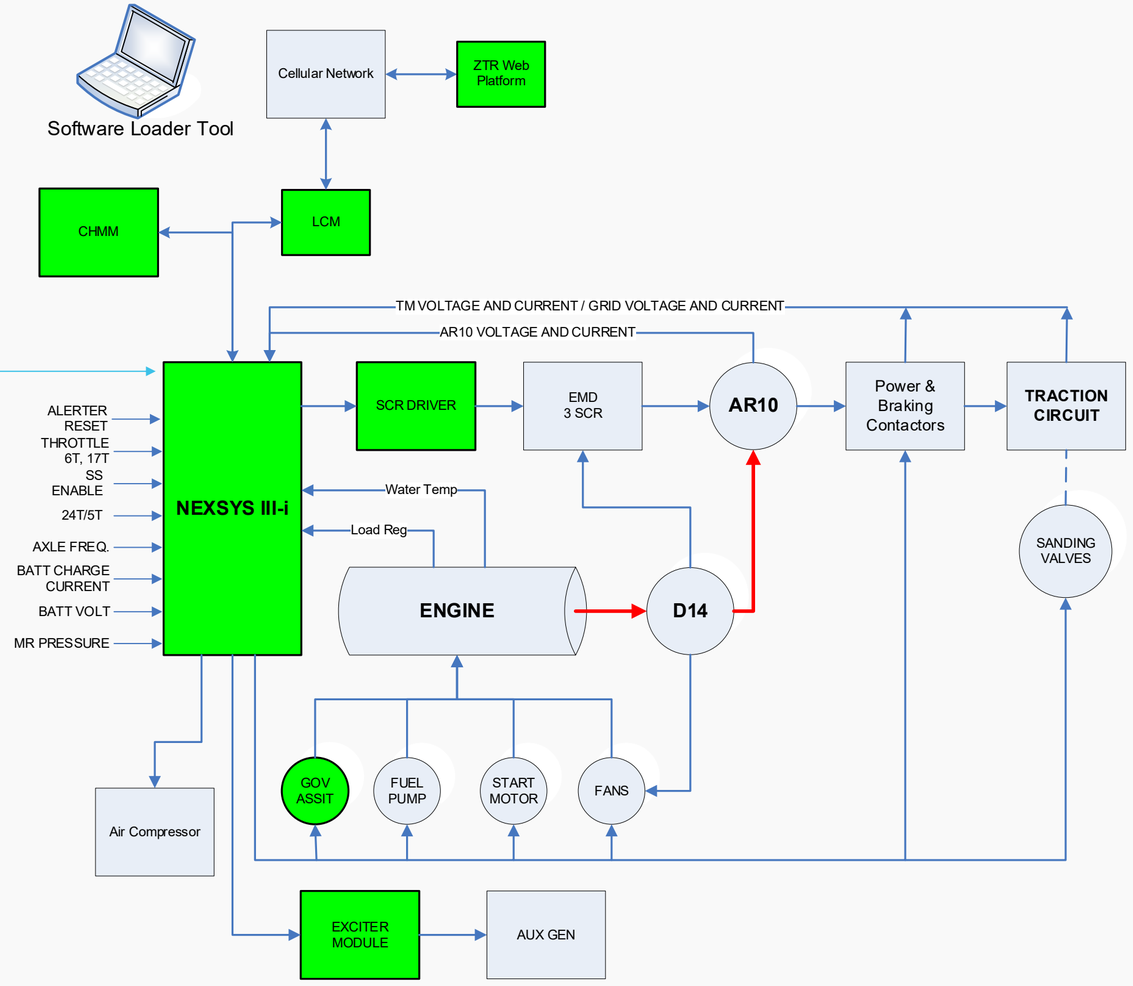
NEXSYS Locomotive Control System

Integrated Locomotive Display

- Head/End of Train (HOTD/EOT)
- Electronic Airbrake (EAB)
- Distributed Power (DP)
- Cab Signal
- Vigilance
- Ground Speed

Locomotive Control Systems

How it Works



NEXSYS Locomotive Control System

Remote Monitoring Platform

24/7 access to near real-time data from all NEXSYS equipped locomotives

- Data Collection
- Fleet Management
- API Integration

NEXSYS Locomotive Control System

Emissions & Cost Reduction

High In-Service Fleet

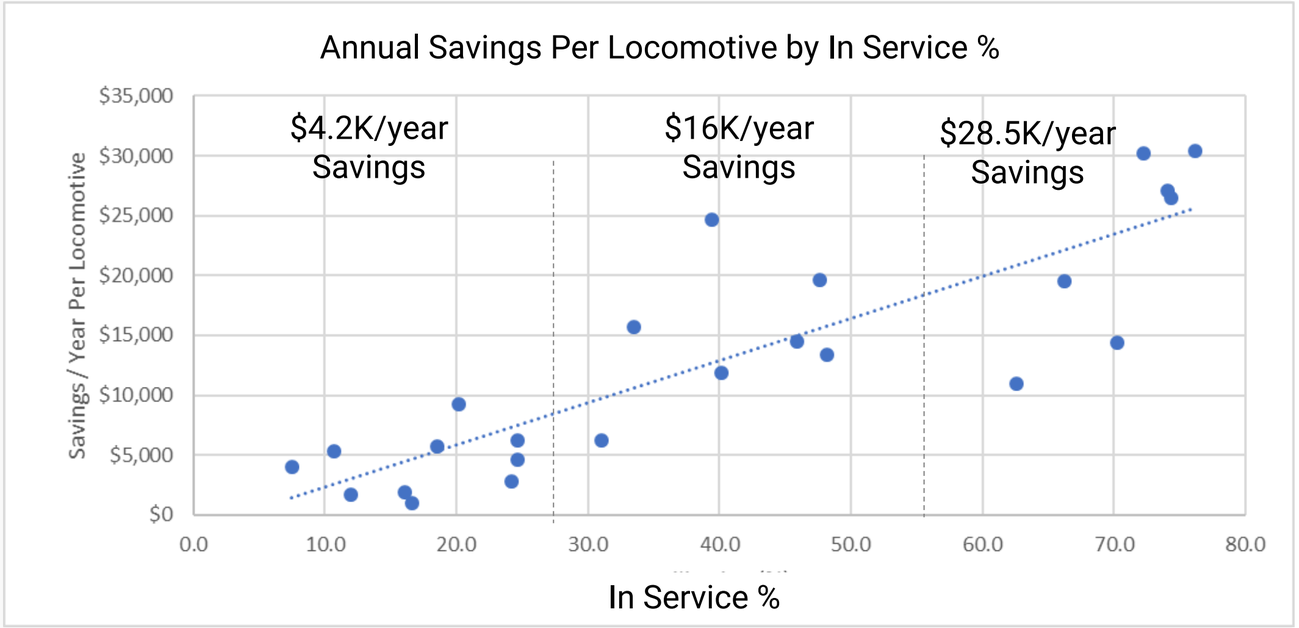
- 74% in-service sees $28.5K/year average savings

Medium In-Service Fleet

- 50% in-Service sees $16.0K/year average savings

Low In-Service Fleet

- 17% in-Service averages $4.2K/year



NEXSYS Locomotive Control System

Case Study

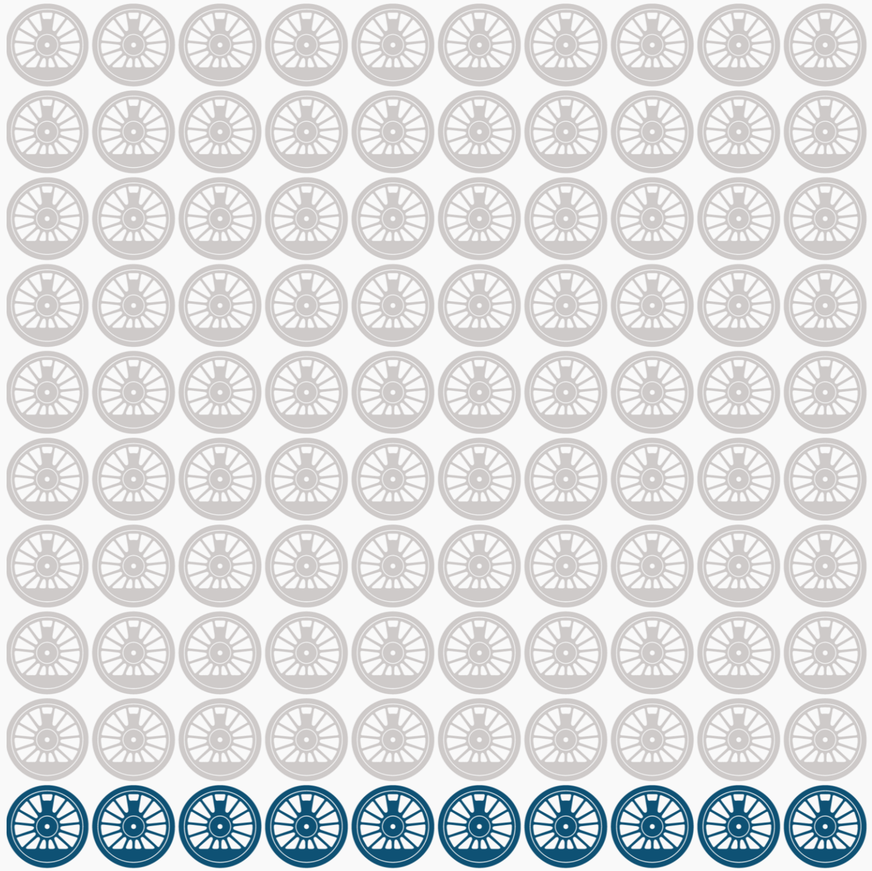
Traction Motors

A client with NEXSYS III-i installed achieved a 90% reduction in DC traction motor replacements due to NEXSYS motor protection algorithms.

A client who changed over 1,000 DC traction motors annually due to flash over (overvoltage), thermal damage (overcurrent) and commutator burn damage (high stall currents) indicated replacement costs:

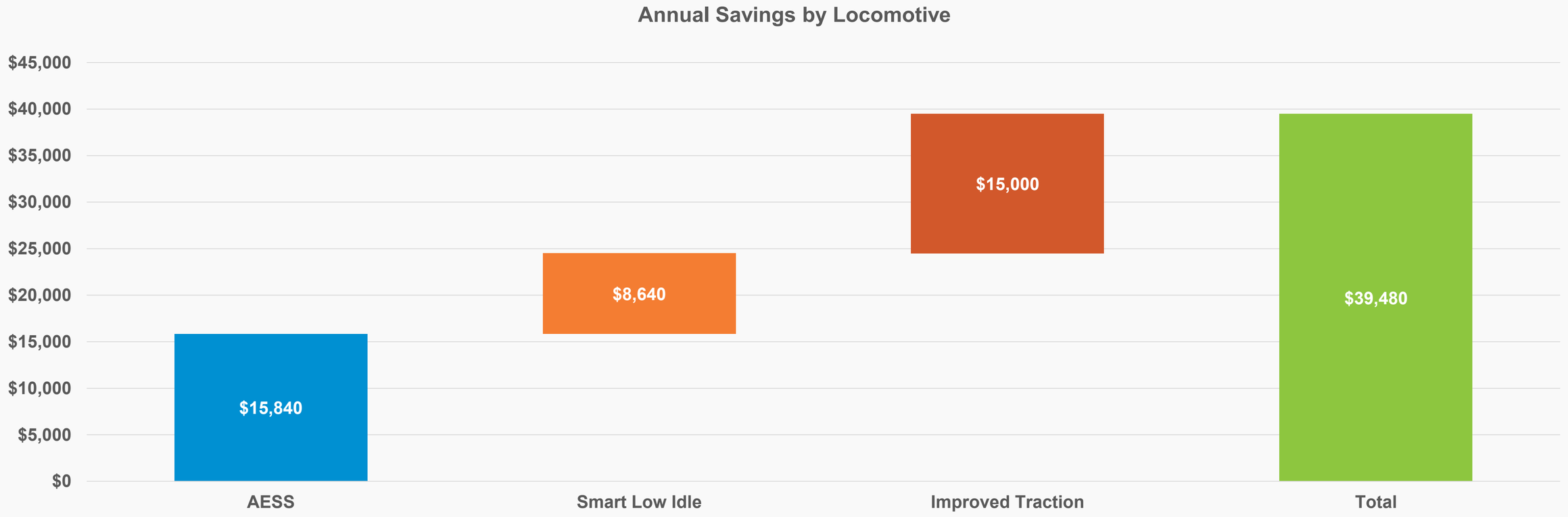
$20,000
per traction motor replacement

Savings would then be:
1,000 * 90% = 900
avoided traction motor replacements
$18M **in savings**



NEXSYS Locomotive Control System

Return on Investment



1250 liters/month with most advanced industry AESS System

680 liters/month with Smart Low Idle

Remove 1/3 engines with 44% increase in tractive effort and adhesion at low speeds

Q&A

Australia's leading rail and transit systems provider, at AusRail 2024.

Come visit the Downer and ZTR team at stand 173 from 26 to 27 November.

Thank You!