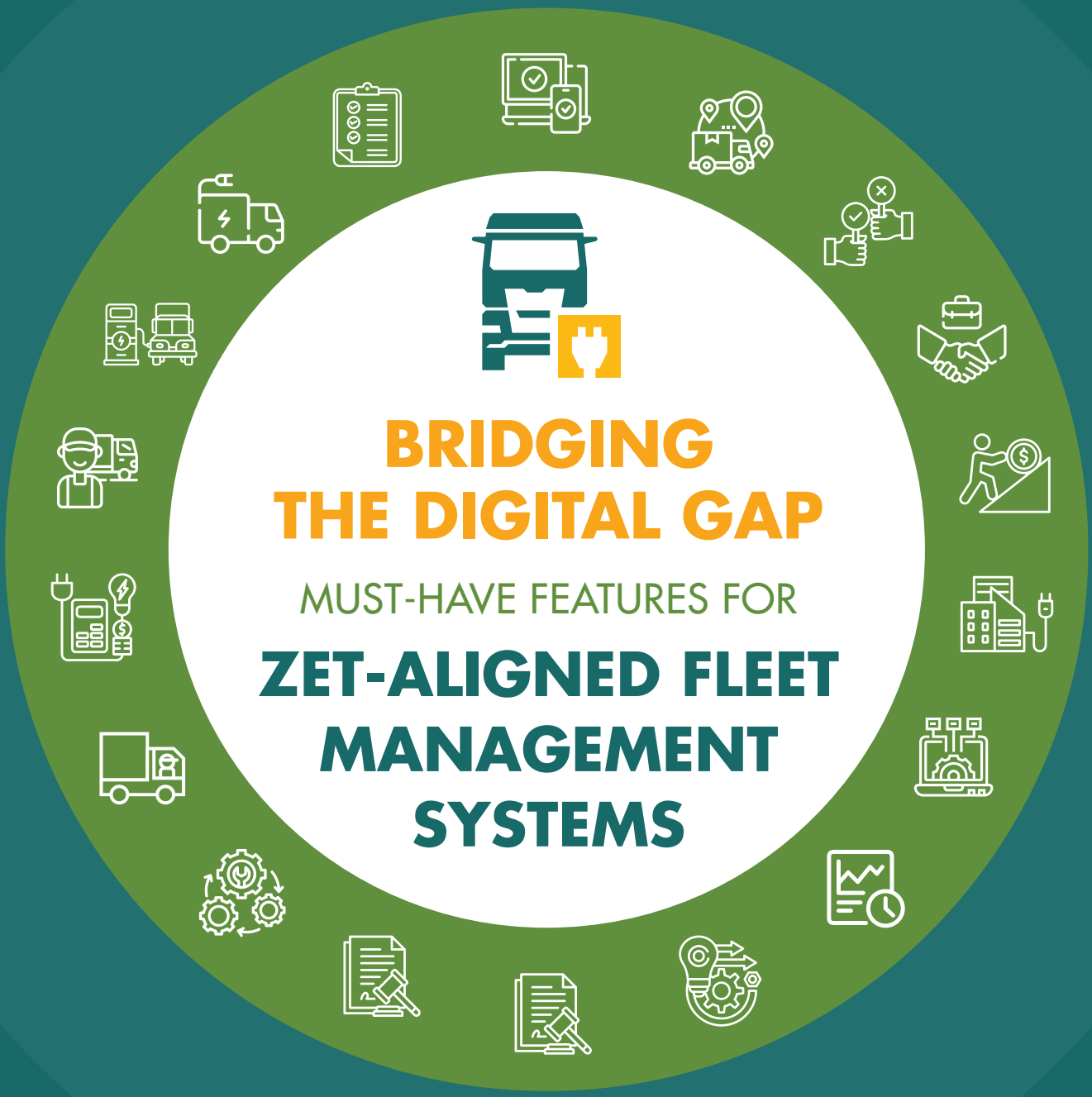

BRIDGING THE DIGITAL GAP

MUST-HAVE FEATURES FOR

ZET-ALIGNED FLEET MANAGEMENT SYSTEMS

ISSUE BRIEF

MARCH 2025

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CENTRE FOR ZERO EMISSION TRUCK TRANSITION SUPPORT

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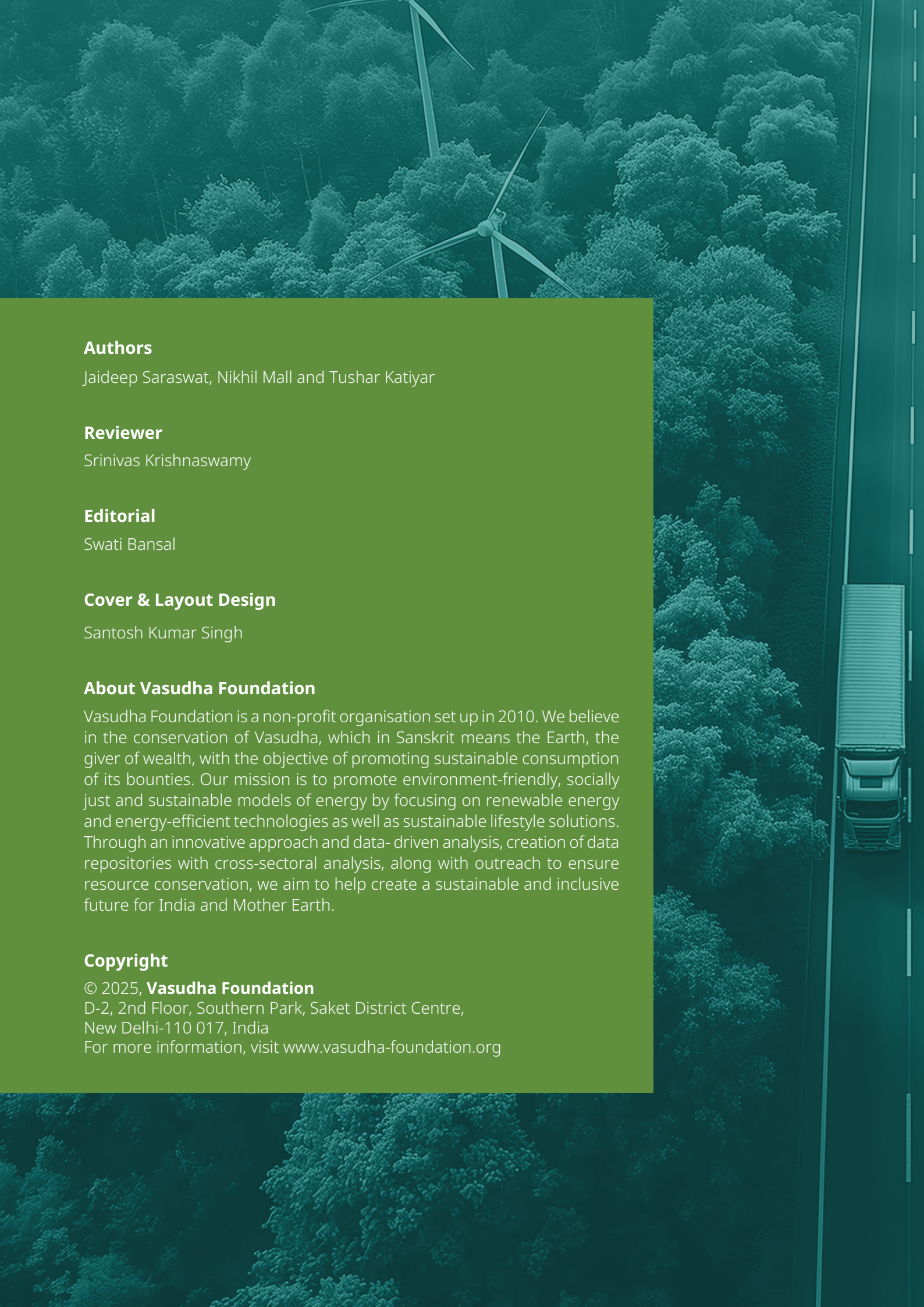

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About Vasudha Foundation

Vasudha Foundation is a non-profit organisation set up in 2010. We believe in the conservation of Vasudha, which in Sanskrit means the Earth, the giver of wealth, with the objective of promoting sustainable consumption of its bounties. Our mission is to promote environment-friendly, socially just and sustainable models of energy by focusing on renewable energy and energy-efficient technologies as well as sustainable lifestyle solutions. Through an innovative approach and data- driven analysis, creation of data repositories with cross-sectoral analysis, along with outreach to ensure resource conservation, we aim to help create a sustainable and inclusive future for India and Mother Earth.

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1. Introduction

India ranks fifth in GDP[1] as of 2023 and is also the fastest growing major economy with a projected growth rate of 6.7 percent for the next two financial years, compared to the expected global average of 2.7 percent[2]. At this rate, India is projected to become the third-largest economy by 2030-31[3]. To reach this milestone, there is a need for a strong and efficient logistics ecosystem, as seamless transportation and supply chain networks are critical to sustaining high economic growth. Logistics plays a pivotal role in contributing to a nation's GDP by facilitating the movement of goods, which is essential for production, trade, and consumption. Trucks, primarily heavy-and-medium-duty, transport nearly 70 percent of India's total freight[4]. Thus, the importance of trucks to our growing economy cannot be understated.

However, inefficiencies in fleet management are a major stumbling block for the sector. Operational inefficiencies arising from a lack of digitalisation—such as suboptimal route planning, lack of real-time monitoring, unplanned downtime, poor driver accountability, and neglected vehicle maintenance—can cost a fortune. Additionally, challenges like fuel pilferage, inefficient load management, excessive idling, inadequate utilisation of return loads, and traffic congestion further exacerbate these inefficiencies, leading to higher operational costs and reduced profitability[5]. The shortage of long-haul trucking drivers is impacting the sector. As per the experts, truck-to-drivers ratio has fallen from 1:1.3 in 1980s to 1:0.6 today[6], exacerbating delays and increasing costs for fleet operators.

The Need for Digitalisation in Trucking Operations

Digitalisation is essential for effectively managing truck fleet operations. It involves integrating telematics, real-time data analytics, artificial intelligence, and automation to streamline operations. Real-time tracking and data-driven decision-making allow fleet operators to address challenges proactively, such as fuel inefficiencies, fluctuating demand, and compliance with new industry regulations. Additionally, automated fleet management systems (FMS) help reduce human errors, improve safety, and ensure compliance with legal and environmental standards. Implementing these digital solutions has demonstrated a reduction in operational cost by 10 to 20 percent and an approximate reduction in the total cost of ownership (TCO) of a truck by at least 2.1 percent[7]. The key benefits of integrating digital solutions into fleet management are illustrated in Figure 1.

1 https://data.worldbank.org/indicator/NY.GDP.MKTP.CD?most_recent_value_desc=true
2 https://pib.gov.in/PressReleasePage.aspx?PRID=2094025
3 https://www.spglobal.com/en/press/press-release/india-is-set-to-become-the-third-largest-economy-by-2030-31
4 https://www.niti.gov.in/sites/default/files/2023-02/ZETReport09092022.pdf
5 https://irdeto.com/blog/the-hidden-costs-of-inefficient-fleet-tracking#:~:text=Unplanned%20downtime%20can%20burden%20fleets,by%20as%20much%20as%2075%25.
6 https://economictimes.indiatimes.com/industry/transportation/roadways/shortage-of-long-haul-truck-drivers-hits-logistics-industry/articleshow/110627088.cms?from=mdr
7 https://www.transportation.gov/sites/dot.gov/files/2025-01/Freight%20Digital%20Solutions%20and%20Emerging%20Technology.pdf

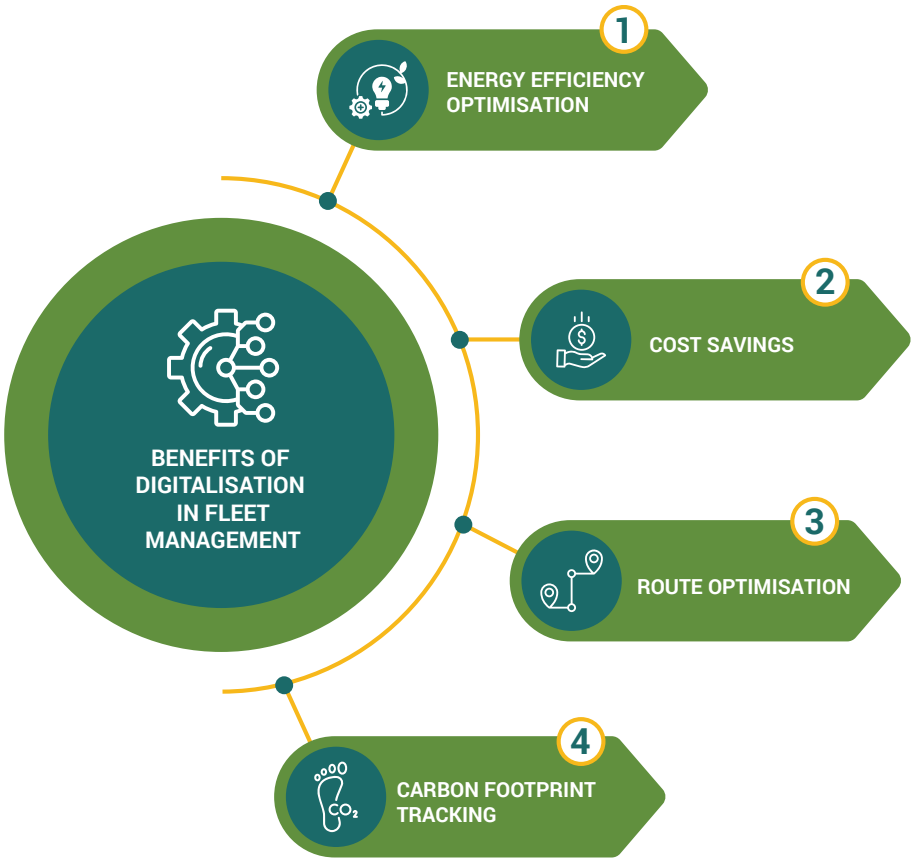

Figure 1: Benefits of Digitalisation in Fleet Management

Beyond operational benefits, digitalisation is becoming increasingly crucial due to growing sustainability concerns. Transport is the fourth largest source of greenhouse gas (GHG) emissions[8] globally. In India, road transport accounts for 12 percent of all energy-related emissions[9]. Government policies and industry regulations are increasingly mandating lower emissions, making it essential for companies to monitor their logistics-related emissions—because what gets measured gets managed. Digital platforms play a crucial role in this process by offering insights into energy consumption and facilitating the integration with renewable energy sources. Also, an advanced truck routing system can significantly reduce vehicle miles travelled (VMT) and associated emissions. A study conducted with a medium-sized logistics company found that implementing an advanced scheduling and routing system for urban deliveries led to a 27 percent reduction in CO_2 emissions[10]. Additionally, the company managed to maintain the same delivery volume while reducing the number of routes by 8.6 percent, decreasing service time by 18 percent, and cutting short kilometres travelled per route by 21 percent[10]. As the industry shifts toward greener solutions, digitalisation will serve as the bedrock for creating a more efficient, cost-effective, and environmentally responsible trucking sector.

The Onset of Transition to Zero Emission Truck (ZET) Fleets

ZETs are vehicles that do not emit exhaust gases or pollutants from their onboard power sources, regardless of their operational mode or conditions. They typically include battery electric vehicles, fuel cell vehicles powered by green hydrogen, and green hydrogen-based

8 https://www.ipcc.ch/report/ar6/wg3/chapter/chapter-10/#:~:text=The%20transport%20sector%20directly%20emitted,land%20use%20(AFOLU)%20sectors.
9 https://iea.blob.core.windows.net/assets/9635288b-5794-40e3-9898-d685aa8ad315/TransitioningIndiasRoadTransportSector.pdf
10 https://www.mdpi.com/2079-8954/8/4/49

internal combustion engine vehicles, all of which generate zero climate emissions and do not contribute to air pollution. As the global transportation sector embraces sustainability, ZETs are emerging as a critical solution for reducing GHG emissions and lowering dependence on fossil fuels. The integration of digital solutions with ZET operations is not just a necessity but a natural progression that enhances the efficiency, reliability, and viability of these advanced vehicles. A recent TCO analysis[11] across truck segments (5-55 Gross Vehicle Weight) found that diesel and battery electric trucks (BETs) have comparable costs over an 8-year lifespan. However, when the analysis was extended to a 15-year horizon, factoring in battery replacement, BETs emerged as the more cost-effective option across all categories.

The Role of Digital Fleet Management in Maximising ZET Efficiency

The transition to ZETs presents new challenges, including battery management, coordination of charging infrastructure, and energy optimisation. The adoption of FMS offers a seamless and effective solution to address these issues, facilitating the smooth integration of ZETs into existing logistics frameworks.

One of the most significant challenges associated with ZET adoption is energy management, particularly concerning battery monitoring, charging optimisation, and range prediction. FMS equipped with advanced telematics and predictive analytics will enable fleet operators to monitor real-time battery health, schedule optimal charging times, and anticipate maintenance requirements. These systems help minimise downtime and maximise vehicle uptime, ultimately improving fleet productivity.

Moreover, the availability and accessibility of charging infrastructure play a crucial role in the operational feasibility of ZETs. Digital tools enable real-time tracking of charging station locations, availability, and pricing, allowing fleet operators to plan efficient routes that reduce energy wastage and eliminate range anxiety. Additionally, data-driven insights from these platforms can support better grid integration by aligning charging schedules with periods of lower electricity demand, thereby reducing costs and improving overall energy efficiency.

Safety and driver performance are also key considerations in the successful deployment of ZETs. FMS provide enhanced safety features, such as remote diagnostics, predictive maintenance alerts, and driver behaviour analysis, ensuring that ZET fleets operate at peak efficiency. These platforms can also facilitate driver training programs, equipping personnel with the skills needed to optimise energy consumption and adapt to the unique driving characteristics of electric trucks.

From a sustainability perspective, digital platforms play a pivotal role in tracking and reporting emissions reductions, which are essential for regulatory compliance and corporate sustainability initiatives. Automated reporting tools integrated into FMS enable logistics companies to accurately measure their carbon footprint, align with government-mandated sustainability goals, and access incentives for green transportation initiatives.

By leveraging the capabilities of digital solutions, fleet operators can ensure a seamless transition to ZETs, addressing key operational, economic, and environmental challenges. The convergence of digitalisation and zero-emission technology represents a transformative opportunity for the trucking industry, enhancing efficiency, reducing costs, and paving the way for a more sustainable future.

11 https://www.vasudha-foundation.org/wp-content/uploads/ZET-Model-Roadmap-2.pdf

2. Objective of the Issue Brief

As the transition to ZETs becomes both inevitable and imminent, the simultaneous adoption of digital solutions by fleet operators is gaining momentum. It is essential to ensure that digital platforms are not only prepared but also well-equipped to seamlessly integrate the unique operational requirements of ZETs. A future-ready FMS must address the intricacies of battery-electric and hydrogen-powered vehicles while optimising efficiency, sustainability, and cost-effectiveness.

This issue brief aims to:

- **Identify Digitalisation Gaps:** Assessing the limitations of conventional FMS in accommodating the specialised needs of ZETs, such as battery health tracking, charging infrastructure coordination, and real-time energy optimisation.
- **Define Critical System Requirements:** Outlining the key features necessary for an advanced FMS for ZETs, including predictive maintenance, intelligent route planning, and carbon footprint tracking.
- **Highlight Strategic Advancements:** Exploring innovations such as AI-driven analytics, smart grid integration, automated compliance reporting, and policy-driven incentives that can facilitate a smoother and more efficient transition to ZETs.

3. Current Digitalisation Gaps vis-a-vis ZETs

Current FMS are primarily designed for internal combustion engine (ICE) vehicles and lack the advanced digital capabilities needed to optimise ZET operations. While existing digital platforms have improved route planning, driver monitoring, and fuel efficiency tracking for conventional trucks, they do not effectively cater to the specific requirements of ZETs. These limitations impede seamless fleet integration, operational efficiency, and cost optimisation. Key limitations include:

Lack of Advanced Battery Monitoring and Management

Battery health and performance are critical for ZETs, yet most FMS lack robust telematics solutions to track key battery parameters such as state of health (SoH), degradation trends, and remaining useful life (RUL). Effective battery management is necessary for optimising vehicle uptime, reducing unexpected breakdowns, and ensuring cost-effective operations. Without real-time battery diagnostics, fleet operators risk reduced battery lifespan due to suboptimal charging practices and inefficient energy use.

Inadequate Charging Infrastructure Integration

Unlike traditional fuel stations, charging infrastructure for ZETs is still developing, requiring precise planning to avoid range anxiety and delays. Existing FMS do not provide real-time charger availability, pre-booking options, or energy grid integration. Advanced telematics solutions can map charging stations route-wise, provide real-time updates on availability, and integrate with vehicle-to-grid (V2G) systems to enable optimised charging during off-peak hours, reducing costs and improving grid efficiency.

Limited Fleet and Route Optimisation Capabilities

ZETs require advanced FMS that consider factors such as terrain, weather conditions, and traffic density to optimise route planning. Current digital systems do not adjust dynamically for these variables, leading to inefficient battery use and increased operational costs. Fleet operators require solutions that leverage real-time vehicle data and AI-driven analytics to optimise routes and minimise unnecessary charging stops.

Lack of Predictive Maintenance Features

Predictive maintenance is crucial for ZETs to ensure extended battery life and minimise downtime. Existing FMS lack predictive analytics to monitor battery health, motor efficiency, and energy consumption. A well-integrated FMS can analyse real-time vehicle

diagnostics, alert fleet operators to potential issues, and proactively schedule maintenance, thus reducing unplanned breakdowns and improving overall fleet efficiency.

Subpar Communication and Alerts System

Current digital platforms lack sophisticated alert systems tailored for ZET fleets. Drivers and fleet operators require real-time notifications for low battery warnings, charging spot availability, and system malfunctions. Telematics-enabled alerts via SMS or in-app notifications can provide instant updates on charging status, maintenance needs, and potential operational disruptions, allowing for proactive decision-making.

Table 1 below summarises the major digitalisation gaps in existing FMS and why specialised solutions are necessary for ZET operations.

Table 1: Comparison of ICE vs ZET FMS Requirements

Key Features	ICE Fleet Management	ZET Fleet Management
Battery Health Tracking	Not required (fuel-based vehicles)	Critical for battery longevity and efficiency
Charging Infrastructure Integration	Not applicable (fuel stations widely available)	Essential for route planning and charging optimisation
Predictive Maintenance	Focuses on engine wear and fuel system checks	Requires monitoring for battery degradation and charge cycle tracking
Energy Consumption Monitoring	Tracks fuel efficiency and consumption patterns	Real-time energy usage tracking, efficiency optimisation, and regenerative braking insights
Route Optimisation	Focuses on fuel efficiency and shortest route selection	Requires route planning that considers terrain, weather, payload, traffic density, and charging station locations
Sustainability Metrics & Reporting	Limited to fuel usage and emissions tracking	Comprehensive carbon emissions tracking, integration with Global Logistics Emissions Council (GLEC) standards, and sustainability reporting
Driver Behaviour Insights	Tracks fuel consumption, braking, and idle time	Monitors acceleration patterns, braking, and idle time
Security & Alarms	Standard vehicle security (GPS tracking, engine immobilisation)	Advanced features such as low battery alarms, charging session security, and remote immobilisation

4. Features of the Fleet Management System for Seamless ZET Integration

After analysing key gaps in existing FMS and engaging with fleet operators and solution providers, it is evident that a robust and future-ready FMS is essential for the seamless integration of ZET fleets. The system must be designed to ensure optimal performance and efficiency. By leveraging advanced digital solutions, it should enhance vehicle efficiency, minimise operational costs, and support sustainability initiatives. Figure 2 highlights the key features that are to be included with upcoming ZET-capable FMS. While addressing critical aspects such as battery health monitoring, charging optimisation, predictive maintenance, and real-time operational insights, this comprehensive framework will enable a smooth transition to ZETs while maximising fleet productivity and long-term viability.

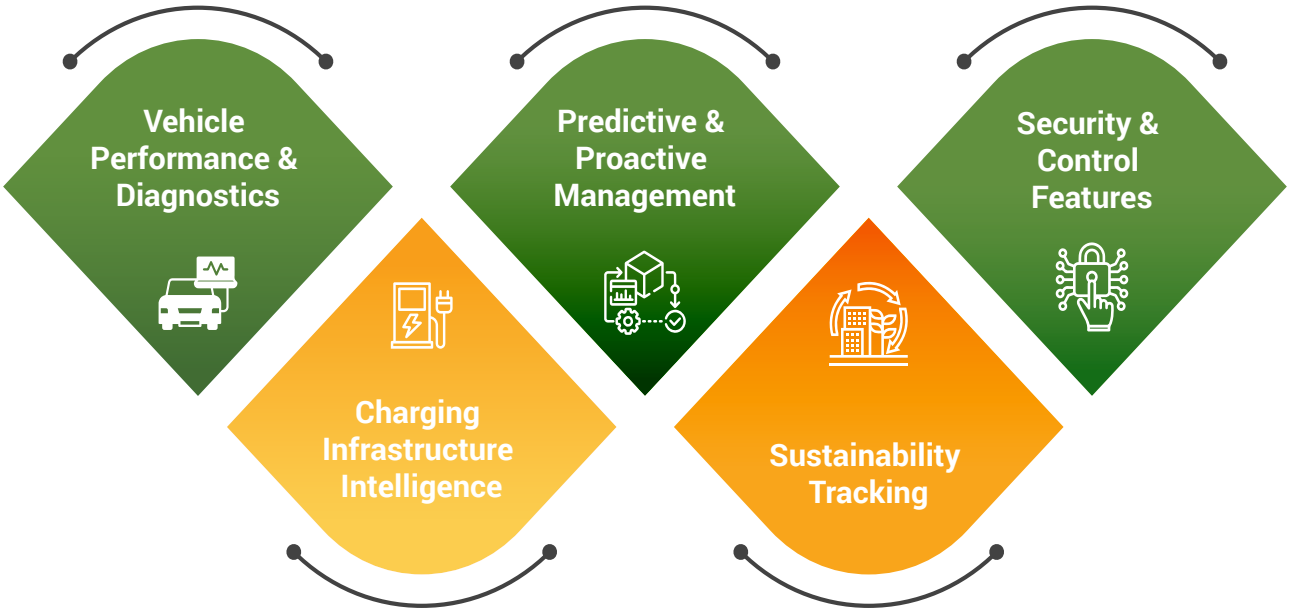

Figure 2: Key Features of ZET Aligned Fleet Management System

Vehicle Performance and Diagnostics

Effective FMS for ZETs requires robust monitoring and diagnostic capabilities to optimise vehicle performance and maximise efficiency. This solution should provide advanced vehicle performance and diagnostics tools categorised into two key areas: real-time monitoring and energy management tools.

Real-time Monitoring

Real-time monitoring is essential for tracking key vehicle parameters and ensuring operational efficiency. The system should continuously gather and analyse data to provide fleet operators with actionable insights. Key features include:

- **Estimated Range:** The system calculates the estimated range of the vehicle by considering factors such as terrain gradient, acceleration patterns, current speed, weather conditions, payload weight, traffic density, and driving mode. This enables better trip planning and minimises range anxiety.
- **EV Gear State:** Provides real-time insights into the truck's gear state, allowing fleet supervisor to monitor whether the vehicle is idling or in drive mode.
- **Battery Parameters:**
  - **State of Charge (SoC):** Displays the real-time charge level of the battery, helping operators effectively plan trips and charging schedules.
  - **Battery State of Health (SoH):** Assesses the overall condition of the battery and predicts the remaining useful life. It helps determine when maintenance or replacement is needed based on thresholds established by fleet operators.
  - **Battery Degradation Trend Analysis:** Continuously tracks battery wear over time to predict when performance degradation may impact operational efficiency.
  - **Charge-Discharge Cycle Count:** Monitors the number of completed charge-discharge cycles, helping fleet operators assess battery lifespan and plan for replacements accordingly.
- **Regenerative Braking Efficiency Monitoring:** Measures the effectiveness of regenerative braking, which typically recaptures 60-70 percent of kinetic energy and returns it to the battery. Factors such as vehicle size, weight, driving conditions, terrain, and battery SoC influence braking efficiency. However, by analysing these variables, the system can detect declines in regenerative braking performance, identify underlying causes, and recommend appropriate corrective actions.
- **Battery and Motor Temperature Monitoring:** The system should continuously measure the temperature of both the battery and motor to ensure they operate within safe limits. If the temperature reaches a critical threshold, automated alerts should notify driving partners as well as the fleet operators to take preventive action, reducing the risk of overheating-related failures.

Energy Management Tools

Energy efficiency is crucial for reducing operational costs and ensuring optimal vehicle performance. The system should provide a suite of energy management tools to help fleet operators track and optimise energy consumption. Key features include:

- **Distance Since Last Charge:** Monitors the distance travelled since the last charging session, enabling better allocation of energy consumption across factors such as traffic conditions, terrain gradient, speed, and other variables.
- **Charging Time Monitoring & Trend Analysis:**
  - **Real-Time Charging Duration Tracking:** Measures the time taken to charge the battery at each session to help optimize charging schedules.
  - **Historical Trend Analysis:** Analyses patterns in charging duration over time to identify variations due to battery health, charging infrastructure efficiency, and grid conditions.
  - **Actionable Insights:** Provides fleet operators with recommendations if charging times increase significantly, indicating potential battery degradation or inefficiencies in charging operations.

- **Energy Consumption Tracking:**
  - » **Total Daily Energy Usage:** Provides insights into the total energy consumed over a day, enabling better fleet-wide energy management.
  - » **Energy Consumed in the Last Trip:** Displays energy usage per trip, helping analyse driving efficiency and optimise future routes.
  - » **Operating Cost per Kilometre:** Calculates cost per kilometre based on energy consumption, assisting in financial planning and cost reduction.
- **Driver Energy Conservation Alerts at Low SoC:** Sends alerts to drivers when the battery charge reaches a critical level. Also, provides recommendations for the next steps:
  - » **Moderating Speed:** Provides insights on speed optimisation to maximise battery efficiency.
  - » **Optimising AC Usage:** Suggests strategies for reducing auxiliary power consumption, particularly air conditioning, to extend battery range.
  - » **Battery Depleting at a Fast Rate:** Detects rapid battery depletion and recommends a hard stop to prevent vehicle breakdown.
- **Analysis of Suboptimal Charging Performance:** Provides insights to driving partners and fleet operators regarding why a vehicle is not charging at the expected rate compared to the charging station's power capacity. Contributing factors may include battery temperature variations, power sharing among multiple vehicles, a high state of charge nearing 100 percent, and other relevant conditions.

Charging Infrastructure Intelligence

A well-integrated charging ecosystem is crucial for ensuring the efficiency and reliability of ZETs. The FMS should provide comprehensive insights into charging infrastructure to optimise vehicle uptime, minimise wait times, and facilitate seamless integration with renewable energy sources. As highlighted in Figure 3, the key features to be included are:

Charger Specifications

To facilitate seamless charging, the system should provide comprehensive information on public charging stations. This should include:

- **Types of Chargers Available:** Displaying details about the compatibility of different charger types (e.g., slow, fast, and ultra-fast chargers[12]) to help fleet operators make informed charging decisions.
- Charger Capacity Information: Offering data on power output levels to ensure vehicles are charged at an optimal rate, balancing speed and battery health.
- **Real-time Charger Availability Status:** Providing live updates on the status of charging stations to prevent unnecessary downtime and allow for better route planning.
- **Probable Time to 100% SoC:** Estimating the time required to achieve full charge, enabling better trip planning.
- **Probable Wait Times:** Predicting charging station congestion to assist drivers in making timely and efficient charging decisions. The system should not only estimate the current congestion at a charging station but also factor in the time it will take for the vehicle to reach the station.

12 Despite their high-rated capacity, high-powered DC chargers (e.g., 360 kW) typically operate at a much lower peak power, often around 90 kW, due to factors such as grid limitations and battery acceptance rates. This inefficiency can lead to extended charging times and increased operational downtime. To address this, split battery charging—where the battery is divided into multiple smaller modules that can charge simultaneously—emerges as a viable alternative, optimizing charging speed and energy utilization.

Charging Tariff Information

To optimise operational costs, the system should provide:

- **Real-time Pricing Information:** Provides insights into charging costs across different stations, enabling fleet managers to strategically plan stops at locations offering the most cost-effective rates.
- **Dynamic Pricing Alerts:** With many charging stations adopting dynamic pricing based on peak and off-peak trends, the system should notify operators in real-time to enable strategic charging decisions and optimise energy costs.

Renewable Energy (RE) Support Indicator

To align with sustainability goals, the system should:

- **Identify Renewable Energy-Integrated Charging Stations:** Providing visibility into charging stations that use energy from solar, wind, or other renewable energy sources.
- **Promote Green Charging Decisions:** Encouraging fleet operators to prioritise RE-supported stations to minimise the carbon footprint of their operations.

Advanced Charging Slot Booking System

Effective management of charging slot is essential for reducing downtime and preventing long queues that could disrupt trip schedules. The portal should feature:

- **Real-time Booking for Nearby Stations:** Allowing fleet operators to reserve charging slots in advance to ensure uninterrupted operations.
- **Dynamic Slot Allocations:** Utilising AI-driven scheduling to optimise slot assignments, thereby reducing wait times and maximising station utilisation.

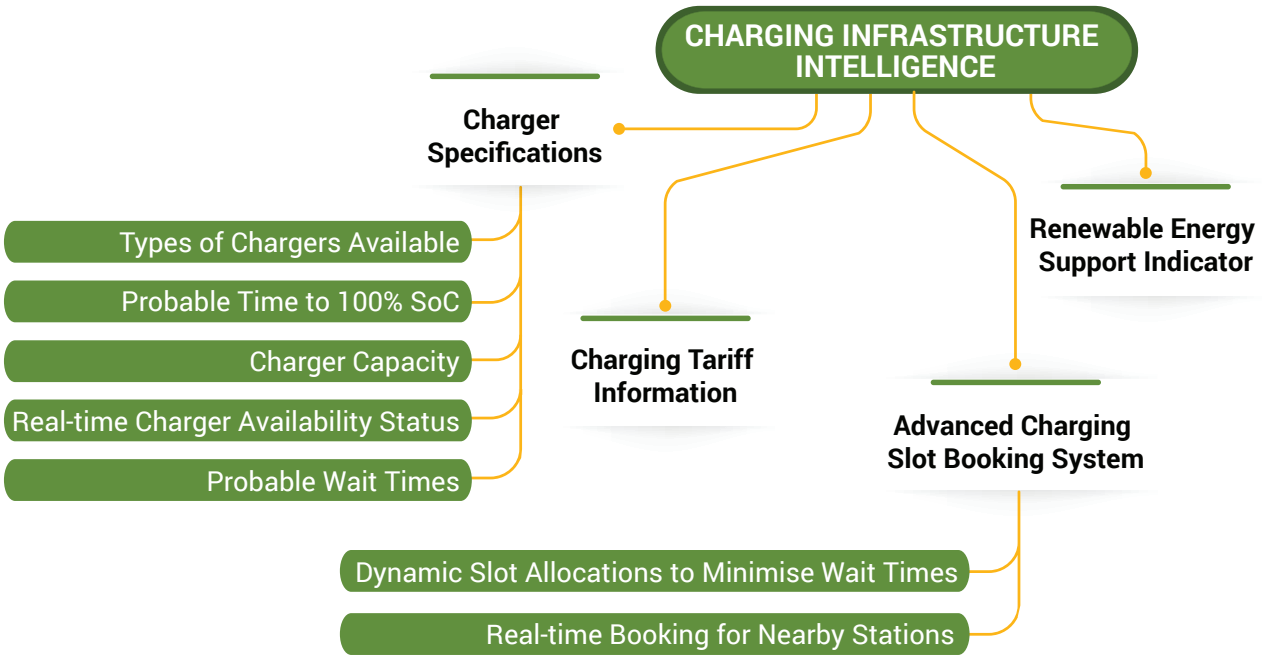

Figure 3: Key Features to be Incorporated as Part of Charging Infrastructure Intelligence

Predictive and Proactive Management

To enhance the reliability and efficiency of ZETs, fleet operators will require predictive and proactive management strategies. A well-integrated FMS should include advanced tools for battery management and emergency support services to minimise downtime and optimise fleet performance. Key features to be included are:

Battery Management

Battery health is a crucial determinant of ZET fleet performance, directly impacting vehicle uptime, operational costs, and overall efficiency. To achieve this, the system should include:

- **Battery Replacement Alerts:** Timely notifications help fleet operators address battery degradation proactively, minimising unexpected breakdowns and costly downtime.
  - » **Customisable Threshold Settings:** Allowing operators to set battery performance benchmarks based on their specific operational needs.
  - » **Proactive Notifications Based on Fleet Operator Preferences:** Sending automated alerts when battery health falls below predefined levels, enabling timely interventions.
- **Predictive Battery Health Insights:** AI-driven analytics can forecast battery degradation trends, allowing operators to make data-backed maintenance decisions and extend battery life.
  - » **Remaining Useful Life (RUL) Estimation:** By analysing charge cycles, usage patterns, and environmental conditions, the system can predict how long a battery will remain viable, enabling planned replacements.
  - » **State of Power Monitoring:** Continuous evaluation of the battery's ability to deliver the required power output, ensuring it meets the high-energy demands of trucking applications. Since trucking operations require sustained high torque for heavy loads, inclines, and long-haul routes, real-time monitoring of power delivery is essential. Any inconsistencies in power output may indicate potential battery degradation or inefficiencies in energy transfer. By assessing power availability relative to operational demands, the system helps fleet operators prevent performance drops, optimise energy distribution, and ensure that vehicles can reliably generate the necessary torque for demanding driving conditions.

Emergency and Support Services

A well-structured emergency support system is vital to ensure minimal disruptions in fleet operations. The FMS should integrate peer-driven insights and roadside assistance solutions to support fleet operators and drivers in real-time.

Peer Learning Platform

Knowledge sharing and industry collaboration play a crucial role in enhancing fleet efficiency. The system should incorporate:

- **Operational Benchmarking:** Offering data-driven insights and performance benchmarks from top-performing fleets within the same segment, enabling operators to analyse key metrics and refine their operations to achieve similar efficiency levels.
- **Community-Driven Insights and Optimisation Strategies:** Creating a platform where fleet operators can share experiences, discuss challenges, and exchange best practices to enhance efficiency, reduce costs, and improve overall fleet performance. By fostering industry-wide collaboration, this feature will help accelerate innovation and will drive continuous improvements in fleet management.

Roadside Assistance Integration

In the event of a breakdown or emergency, quick response mechanisms are vital for minimising downtime. The FMS should include:

- **Emergency Support Button:** Allowing drivers to instantly notify fleet operators and roadside assistance services of an urgent situation.
- **Immediate Breakdown Response Mechanism:** Facilitating the rapid deployment of repair or towing services to affected vehicles, reducing operational disruptions. To enhance response efficiency, FMS providers should explore partnerships with towing service providers, service technicians, and original equipment manufacturer (OEM) repair teams. These collaborations would allow for tailored assistance based on vehicle-specific factors such as age, warranty status, and maintenance history, ensuring the most effective support for each fleet.

Sustainability Tracking

Sustainability is a core priority in the transition to ZETs. Fleet operators must actively monitor and manage their environmental impact to align with global sustainability goals and regulatory requirements. The FMS should incorporate comprehensive environmental impact monitoring tools to quantify carbon reduction efforts, optimise green energy use, and facilitate transparent reporting.

Environmental Impact Monitoring

To enable effective sustainability tracking, the portal should provide real-time insights and automated reporting mechanisms. Key features should include:

- **Carbon Emissions Reduction Tracking:** The system should measure and report the reduction of carbon emissions achieved through fleet electrification and the use of renewable energy for vehicle charging. This will help fleet operators gain valuable data to showcase environmental benefits, meet corporate sustainability commitments, and optimise energy procurement strategies.
- **Renewable Energy Usage Patterns:** The portal should track energy consumption from renewable sources, allowing fleet operators to prioritise charging stations powered by clean energy. This will help optimise fleet sustainability efforts and support the integration of renewable energy into logistics operations.
- **Environmental Performance Reporting:**
  - » **Global Logistics Emissions Council (GLEC) Framework Compliance:** The system should align with GLEC standards to provide standardised emissions reporting, ensuring transparency and compliance with industry benchmarks.
  - » **Automated Report Generation:** The portal should facilitate the automatic generation of sustainability reports, enabling fleet operators to easily monitor environmental impact, streamline compliance with regulatory requirements, and share progress with stakeholders.
  - » **Timeline Selection:** The portal should allow the selection of timeline for reporting.

Security and Control Features

Ensuring the security and control of ZETs is essential for maintaining operational integrity and preventing unauthorised access or misuse. A comprehensive security system within the FMS should include advanced vehicle protection tools to enhance fleet safety and reduce potential risks.

Vehicle Protection Tools

To safeguard ZETs from operational disruptions and security threats, the system should incorporate the following features:

- **Low Battery Alarm System:** The portal should provide real-time alerts when a vehicle's battery reaches a critically low level, ensuring that fleet operators and drivers can take immediate action to prevent unexpected breakdowns.
- **Immobilisation & Wheel Jamming:** The system should enable remote immobilisation of vehicles in case of theft or unauthorised use. This feature ensures that the vehicle cannot be operated without proper authorisation, adding an extra layer of security for fleet operators.
- **Charging Session Security Monitoring:** To prevent unauthorised access to charging infrastructure and ensure safe energy transfer, the system should monitor charging sessions for anomalies. Alerts should be triggered in case of any security breach, such as unauthorised disconnection. Additionally, the system should monitor unexpected voltage drops, surges, or excessive power draw, which could indicate potential tampering or a malfunctioning charger.

5. Conclusion

The transition to ZETs presents both challenges and opportunities for fleet operators, making digital fleet management a critical enabler in this shift. Conventional FMS lack the specialised capabilities needed to support ZET operations, necessitating the development of advanced systems that ensure seamless integration. These systems must incorporate key features such as real-time vehicle diagnostics, insights on charging infrastructure, predictive maintenance, sustainability tracking, and robust security measures.

With the adoption of ZETs gaining momentum at both central and state levels—evidenced by initiatives like the PM E-DRIVE scheme[13] allocating ₹500 crore for BETs and state-level incentives such as those introduced by Madhya Pradesh[14]—it is imperative for digitalisation partners to upgrade their existing fleet management solutions. By integrating the essential elements outlined in this issue brief, fleet operators will be empowered to effectively manage their ZET fleets while maximising operational efficiency. The industry must ensure that as the trucking sector transitions to ZETs, digital fleet management solutions evolve in parallel, reaching a level of sophistication that not only streamlines fleet operations but also enhances the viability and success of new technology-driven transportation.

13 https://pmedrive.heavyindustries.gov.in/
14 https://invest.mp.gov.in/wp-content/uploads/2025/02/MP-EV-Policy-2025_FINAL-1.pdf