Port and Terminal Solutions to Enable Electric Drayage Adoption

A Resource for Ports and Container Terminals

Smart Freight Centre

About Smart Freight Centre
Smart Freight Centre is an international nonprofit organization focused on reducing greenhouse gas emissions from freight transportation. Smart Freight Centre's vision is an efficient and zero emission global logistics sector. Smart Freight Centre works to guide the global logistics industry in tracking and reducing the industry's greenhouse gas emissions by one billion tonnes by 2030 and to reach zero emissions by 2050 or earlier, consistent with a 1.5°C future.

Acknowledgements
This publication was developed based on insights from publicly available sources as well as direct input from advisors and port and terminal operators in developing this report. The report would not have been possible without the support and from the following organizations:

- AECOM
- APM Terminals
- DP World
- High Ambition Climate Collective (HACC)
- Huskey Terminal, Tacoma, WA

However, this document does not necessarily represent the views of any organization listed in these acknowledgements, nor does inclusion of an organization's name in these acknowledgements signify that organization's endorsement of this framework.

Executive Summary

Ports and terminals play a critical role in determining whether electric drayage can operate efficiently and scale successfully. While they do not typically purchase trucks or manage freight contracts, ports and terminals can influence many of the operational conditions that determine utilization, including truck turn times, gate efficiency, charging readiness, operational predictability, and ecosystem coordination. Improving these conditions can increase vehicle utilization, strengthen fleet economics, and accelerate the transition to zero-emission freight.

This resource is intended to help ports and container terminals identify practical actions they can take to support electric drayage deployment. Rather than prescribing a single pathway, it presents operational, infrastructure, commercial, and coordination solutions that are already emerging across global port ecosystems, explains the challenges they are designed to address, and highlights considerations for successful implementation. It also provides a practical framework for assessing local operating conditions, identifying the most appropriate solutions, and translating these into phased implementation plans. The objective is to help ports and terminals determine which approaches are most applicable to their local operating conditions and where they can have the greatest impact.

By focusing on practical implementation, this resource complements existing electrification strategies and provides a structured reference for ports and terminals seeking to accelerate electric drayage adoption at scale. Recognizing that every port ecosystem is different, the guidance is designed to help stakeholders select, prioritize, and sequence solutions based on their own operational context and level of electric drayage deployment.

Table of Contents

1. Introduction

Logistics and freight transport account for approximately 7% of global greenhouse gas emissions, with heavy-duty trucks representing the largest share of those emissions [i, ii]. Within road freight, drayage presents one of the strongest near-term opportunities for electrification. Drayage operations are typically characterized by short, repetitive journeys between ports, terminals, and nearby logistics facilities, where vehicles operate on predictable routes and frequently return to the same locations. Electric truck technology has now reached a level of maturity capable of supporting many of these operations. However, despite this technical readiness, deployment remains limited as carriers continue to face operational uncertainty, infrastructure constraints, and higher upfront costs that challenge the business case for electric drayage.

Accelerating electric drayage therefore requires more than replacing diesel trucks with electric alternatives. It requires the freight system itself to adapt. Improving vehicle utilization, reducing operational uncertainty, coordinating charging infrastructure, and aligning stakeholders across the logistics chain all contribute to making electric drayage commercially viable. Recognizing that no single organization can address these challenges alone, Smart Freight Centre and The Climate Pledge established the Electrifying Drayage Alliance (EDA).

The EDA brings together ports, terminals, trucking companies, shippers, logistics providers, charging providers, vehicle manufacturers, and public sector organizations to identify practical solutions that enable electric drayage deployment. Rather than promoting a single technology or implementation model, the EDA focuses on collaboration, knowledge sharing, and translating operational experience into practical guidance that can be applied across different port environments.

Ports and terminals play a critical enabling role in this transition. While they do not typically procure trucks or determine freight demand, they influence many of the operational conditions that shape electric drayage performance, including operational planning and coordination, gate operations, charging readiness, incentive mechanisms, and ecosystem coordination. Improvements in these areas can increase vehicle utilization, strengthen fleet economics, and create the conditions needed for electric drayage to scale.

This guide has been developed as a practical resource for ports and terminals seeking to support electric drayage deployment. It draws on insights from the EDA, existing industry initiatives, and emerging practices from ports and terminals that are already implementing operational changes to support electric drayage.

The guide first explains why ports and terminals are uniquely positioned to influence electric drayage adoption before examining the operational areas within their control and the solutions currently being deployed across global port ecosystems. It then provides a framework for assessing local operating conditions, identifying the most appropriate combination of solutions, and translating these into an implementation approach. Drawing on examples and lessons from early adopters, the objective is to help ports and terminals identify where they can have the greatest impact while maintaining safe, reliable, and efficient terminal operations.

2. Ports and Terminals as Enablers of Electric Drayage

Ports and terminals are uniquely positioned to influence the conditions that determine whether electric drayage can operate efficiently and scale successfully. Although they do not control every aspect of the freight system, they can shape many of the operational factors that affect vehicle utilization and fleet economics. This chapter explains why drayage represents an attractive early application for electrification, the role ports and terminals play in enabling deployment, and how drayage is defined within the context of the Electrifying Drayage Alliance (EDA).

2.1 Defining Drayage in the Context of the EDA

For the purpose of this document, the Electrifying Drayage Alliance (EDA) uses the term drayage to refer to the short-haul movement of shipping containers between deep sea container terminals and nearby logistics nodes such as warehouses and distribution centers. This document does not focus on intra-terminal cargo handling equipment or container movements occurring solely within terminal boundaries. Instead, the focus is on the truck trips that connect ports to the broader freight ecosystem and that are typically performed by third-party drayage carriers operating in and around port regions.

2.2 Electric Drayage as an Early Electrification Opportunity

Electric drayage is widely recognized as one of the most promising early applications for heavy-duty truck electrification. Unlike many long-haul operations, drayage movements are typically short, repetitive, and centered around fixed logistics hubs, with vehicles frequently operating along predictable routes between ports, terminals, and nearby logistics facilities. These operating characteristics make drayage well suited to current battery-electric truck capabilities and position ports as an important starting point for accelerating freight decarbonization.

Despite this strong operational fit, electric drayage deployment remains constrained by a series of interconnected operational and infrastructure challenges. Long truck queue times, limited terminal operating hours, unpredictable terminal turn times, limited charging availability, insufficient staging infrastructure, and grid constraints all reduce vehicle utilization and increase operational uncertainty. As a result, maximizing productive truck movements while minimizing delays is one of the most effective ways to improve the economics of electric drayage.

2.3 The Port and Terminal's Influence on Utilization and Emissions

Many of the factors that affect vehicle utilization are directly shaped by port and terminal operations. Gate efficiency, appointment systems, truck staging processes, congestion management, and operational coordination all affect vehicle productivity and fleet utilization. While trucking carriers own and operate the vehicles themselves, port and terminal operations strongly influence queue duration, truck turn times, driver productivity, and overall fleet efficiency.

Ports and terminals also have a direct interest in reducing diesel truck activity within and around their facilities. Fewer diesel trucks can help reduce local air pollutant exposure for workers and others operating in port environments, providing benefits beyond greenhouse gas emissions reductions.

For ports and terminals pursuing broader decarbonization strategies, drayage trucking should increasingly be considered part of the wider Scope 3 emissions landscape. How

drayage fits into each port and terminal's Scope 3 portfolio depends on several factors:

- **Purchased transportation services**. Where a port or terminal directly contracts third-party drayage or container transportation services, the associated emissions may fall within its Scope 3 inventory, depending on the organization's reporting boundary and GHG accounting methodology. In most port systems, however, drayage services are procured by cargo owners, logistics providers or motor carriers rather than the port authority itself.
- **Downstream transportation**. Some ports and terminals have already recognized that emissions from drayage trucking should form part of their reported Scope 3 emissions and have chosen to report these as Scope 3, Category 9 emissions. However, this does not appear to fit the existing Scope 3 categories very well.
- **Use of sold products**. Recognizing that the GHG Protocol definition of a product includes provision of services, Scope 3, Category 11 seems a better fit among the existing Scope 3 category definitions, with the service being access to the port or terminal.
- **Facilitated emissions**. Among the forthcoming proposed changes to the GHG Protocol is an additional Scope 3, Category 16: 'Other Emissions', which will include 'Facilitated Emissions' as a subcategory[iii]. This is likely to explicitly refer to the emissions from transport movements that access ports and terminals and that occur within the organizational boundary. However, reporting emissions from the full drayage operation would be encouraged for full reporting, with the statement of the boundary used.

These operational factors directly affect energy consumption, vehicle utilization, and ultimately the economics of electric truck adoption.

Ports and terminals are uniquely positioned to improve the operating conditions that determine whether electric drayage succeeds at scale while strengthening their position within lower-carbon supply chains.

3. Port and Terminal Levers to Support Electric Drayage

Ports and terminals have a range of practical levers that can improve operating conditions for electric drayage. Through operational planning, gate operations, charging readiness, pricing and incentive mechanisms, and stakeholder coordination, ports and terminals can reduce operational uncertainty and improve truck utilization. These factors are particularly important for electric drayage, where vehicle economics are highly sensitive to downtime, congestion, and unpredictable operating conditions.

The five areas of influence presented in this chapter provide different opportunities for ports and terminals to support electric drayage. Within each area, a range of solutions is available, each addressing different challenges and requiring different levels of implementation effort. While no single solution addresses every challenge, combining measures across multiple areas of influence can improve vehicle utilization, strengthen fleet economics, and support the broader deployment of electric drayage. The table below provides an overview of the available solutions and the operational challenges they are intended to address.

Table 1. Overview of Solutions

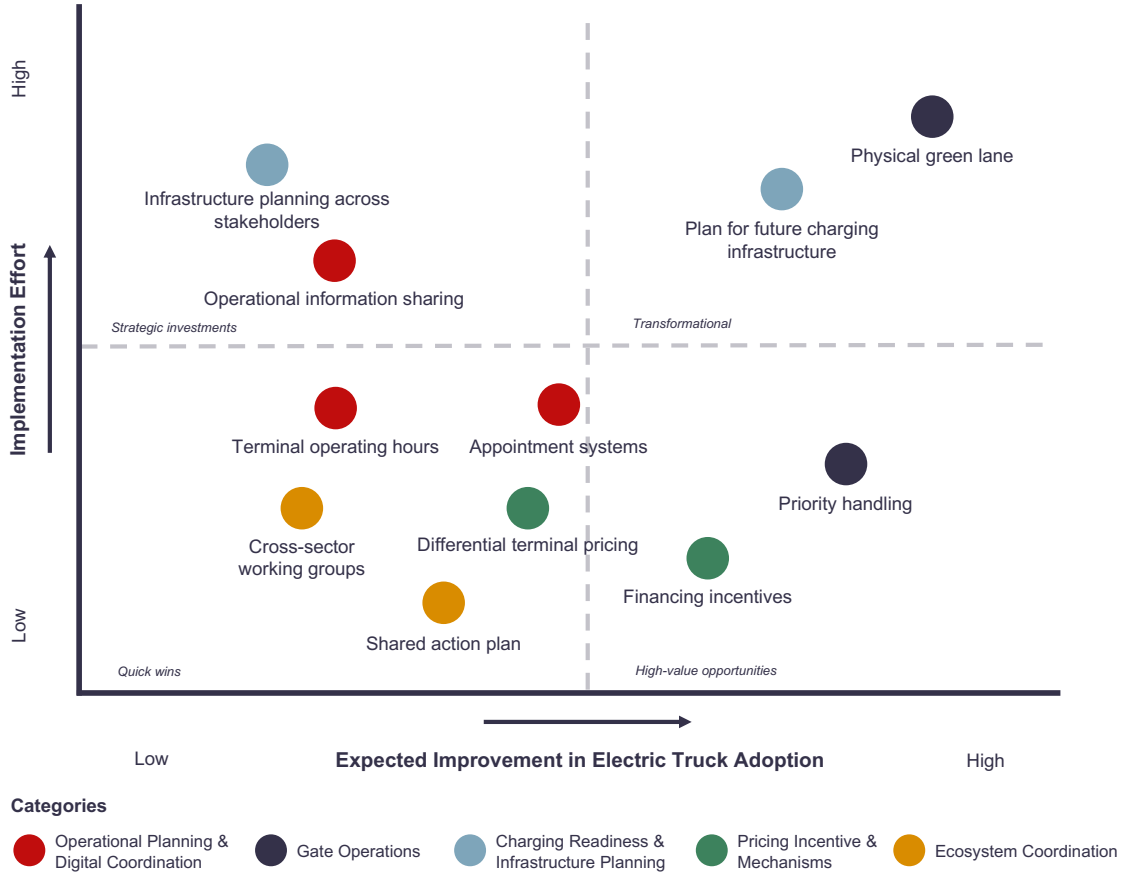
Area of Influence	Solutions	Challenge Addressed
Operational Planning and Digital Coordination	Incentivized appointment systems, operational information sharing, terminal operating hours	Unpredictable truck turn times and limited visibility
Gate Operations	Physical green lane, priority handling	Long queue times and truck congestion
Charging Readiness and Infrastructure Planning	Plan for future charging infrastructure, coordinate infrastructure planning across stakeholders	Charging uncertainty and infrastructure deployment barriers
Pricing and Incentive Mechanisms	Differential terminal pricing, provide financial incentives	Higher costs and adoption risk for electric trucks
Enabling Implementation Through Ecosystem Coordination	Establish cross-sector working groups and partnerships, develop a shared action plan	Fragmented stakeholder decision-making and implementation challenges

The solutions presented in this chapter differ in both the effort required to implement them and their potential contribution to improving electric truck utilization. The relative positioning of each solution will vary by port and terminal, depending on local operating conditions, available resources, and existing systems. The framework below provides an indicative assessment to support discussions on where to begin. It should not be viewed as a prescriptive ranking, but as a practical tool to help ports and terminals prioritize interventions based on their expected operational impact and implementation effort.

In practice, the transition is unlikely to begin with the most transformative measures. Many ports and terminals can make meaningful early progress by adapting existing processes through Quick Wins, before progressing to High-Value Opportunities that more directly improve electric truck utilization. As electric drayage deployment matures, ports and terminals can place greater emphasis on Strategic

Investments that strengthen long-term planning and coordination across the port ecosystem. Transformational solutions generally require the greatest level of investment and planning but can deliver the greatest long-term operational benefits.

Figure 1. Solution Prioritization Framework



The framework highlights that not all solutions require the same level of investment to deliver meaningful operational benefits. Pricing and incentive mechanisms, appointment systems, and ecosystem coordination can often be implemented by adapting existing processes, making them suitable early interventions for many ports and terminals. Gate operation measures, particularly Priority Gate Processing, have the potential to deliver significant improvements in electric truck utilization while requiring relatively limited operational changes where existing systems can be adapted. Physical Green Lanes can provide even greater benefits, particularly at congested terminals. While they are a great solution, green lanes typically require more extensive planning and may be constrained by terminal layout and traffic flows, therefore a consideration between cost and benefits justified by a threshold of number of trucks using the green lane.

3.1 Operational Planning and Digital Coordination

Reducing uncertainty before a truck reaches the terminal can be just as important as reducing delays at the gate. By improving how truck arrivals are planned and how operational information is shared, ports and terminals can help electric trucks minimize unnecessary waiting, improve vehicle utilization, and make daily operations more predictable.

Table 2. Operational Planning and Digital Coordination Solutions

Solution	Description
Incentivized appointment systems	Incorporate electric truck considerations into existing appointment or booking systems. This may include preferred appointment windows and penalties, additional booking flexibility, or financial incentives linked to advance bookings or other operational behaviors that improve truck utilization.
Operational information sharing	Provide carriers with timely information on terminal conditions, expected delays, and container readiness. Improved operational visibility enables electric truck operators to better plan charging, optimize arrival times, reduce unnecessary waiting, and maximize vehicle utilization.
Terminal operating hours	Restricted terminal hours can reduce the number of container movements an electric truck can complete each day. Extended gate hours allow operators to plan movements allowing charging during quieter periods.

DP World London Gateway operates a truck booking system that rewards carriers with a rebate when making off-peak appointments at least 12 hours in advance, and reduced fees when booked in advance during peak hours which aids efficient terminal planning. While the incentive currently applies regardless of vehicle type, the approach demonstrates how existing operational planning tools can encourage behaviors that improve truck utilization. At DP World's UK terminals at Southampton and London Gateway, electric trucks can benefit from an electric truck Vehicle Booking System rebate, which provides additional incentives for electric truck operations.

The *Port of Los Angeles* has deployed the Port Optimizer platform to improve visibility across the supply chain by sharing operational information between terminals and logistics stakeholders. While not designed specifically for electric drayage, increased visibility helps carriers better coordinate truck movements and reduces operational uncertainty, creating a stronger operating environment for electric trucks.

The *Port of Rotterdam*, through the Portbase system, enables digital information sharing between terminals, carriers and logistics partners. It allows terminals to reward truckers for behavior supporting truck flow, such as booking in advance, booking off-peak hours, and showing up on time. By improving coordination across the port ecosystem, the platform supports more predictable truck movements and demonstrates how digital coordination can contribute to more efficient drayage operations. The Port is currently evaluating how to incorporate criteria for electric trucks, which will support planning certainties for carriers with electric trucks in their fleet.

While most major ocean ports and terminals operate on a 24/7 basis, truck and gate operations do not always operate around the clock. Extending truck access into off-peak hours may not always be feasible, particularly when terminals are located near residential communities or local policies limit operating hours. Where feasible, however, off-peak container pickup and drop-off can help truck operators avoid peak congestion, improve vehicle utilization, and better align terminal visits with charging needs[iv,v].

Implementation Insights

- **Embed electric truck incentives into existing processes.** Embed financial or operational incentives into existing terminal processes, such as appointment systems or gate operations, to improve electric truck utilization while maintaining efficient terminal operations.
- **Reward operational behaviors**. Reward trucking carriers for operational behaviors that benefit both the terminal and the carrier, such as advance bookings or arrival reliability.
- **Provide timely operational information**. Share operational information as early as possible to enable carriers to optimize dispatching, charging schedules and arrival times.
- **Consider the maturity of existing digital systems**. Consider digital coordination as part of a broader operational planning strategy, recognizing that the greatest benefits are achieved when appointment systems, information sharing, and gate operations work together.
- **Consider flexible terminal operating hours.** Where feasible, extend truck access into off-peak hours to reduce congestion, improve truck utilization, and better align terminal visits with charging schedules.

3.2 Gate Operations

Truck turn time is one of the strongest determinants of electric truck utilization. By reducing queue times and improving the predictability of gate processing, ports and terminals can increase the number of productive trips an electric truck completes each day, strengthening the business case for electric drayage.

Table 3. Gate Operations Solutions

Solution	Description
Physical green lane	Introduce dedicated gate lanes for electric trucks to reduce queue times during periods of congestion and improve truck utilization.
Priority handling	Prioritize electric trucks in container handling operations to reduce wait times, particularly during peak hours, for example through the Terminal Operating System (TOS).

APM Terminals Pier 400 at the Port of Los Angeles has introduced dedicated, physical green lanes to prioritize cleaner trucks entering the terminal. The initiative demonstrates how dedicated physical priority lanes can reduce truck turn times during periods of heavy traffic congestion and improve vehicle turn time. Initial studies show that this can save trucks an average of 9 minutes of turn time, compared to conventional lanes, and more during peak hours[vi].

Huskey terminal at the Port of Tacoma recognizes that a positive business case for electric trucks rests on how many productive moves trucks make in a day. Much of that is decided at the terminal through turn time and predictability. When planning gate and yard modernization, their focus is on shortening visits. Looking into the future, they recognize a potential for prioritizing electric trucks as volumes grow.

APM Terminals Aarhus implemented priority handling through its terminal operating system by extending an existing priority function to registered electric trucks. Rather than constructing dedicated infrastructure, the terminal adapted its digital processes to prioritize electric truck movements once vehicles entered the terminal. If a terminal already has a prioritization function embedded digitally, then adding electric vehicles requires minimal effort.

APM Terminals Gothenburg combines a physical green lane with digital priority processing. The terminal reports that the greatest benefits are achieved during busy operating periods and highlights the importance of clearly communicating how the priority system works to trucking companies before implementation. The combination has reduced turn time for electric trucks during busy periods by 25% [vii].

"Green lanes and priority processing is most valuable for our customers during periods of peak terminal congestion. Terminals should assess the truck journey end-to-end at the terminal, clearly map out where priority can be given and where it is not possible. Involve customers in designing the solution to ensure the right solutions are offered."

— August Gustafsson, Customer Care Manager at APM Terminals Gothenburg

Implementation Insights

- **Assess both operational needs and site constraints**. Dedicated green lanes can be highly effective where terminal layouts and access roads allow traffic to be distributed safely. Where site constraints limit this approach, priority handling can still reduce turn time once the truck enters the gate.
- **Maintain priority throughout the terminal process.** Where priority access is introduced, the operational benefit is greatest when priority is maintained from the gate lane through to container collection and through to exit.
- **Communicate clearly with carriers before implementation.** Clearly defined operating procedures, eligibility criteria and lane markings help ensure that priority systems are understood and used consistently.
- **Monitor and adapt as electric truck volumes increase**. Measures that work well during early deployment may need to evolve as electric truck volumes grow to ensure they continue supporting truck utilization without adversely affecting overall terminal operations.

3.3 Charging Readiness and Infrastructure Planning

Reliable access to charging is an important enabler of electric drayage. While charging strategies vary between ports, carriers need confidence that charging is available where and when it is needed to support daily operations. Depending on local circumstances, this may involve charging within the port, at nearby logistics facilities or truck parking locations, and/or at dedicated charging hubs that serve the wider port area.

Ports and terminals play an important role in enabling these charging ecosystems. Through long-term planning, land use decisions and stakeholder coordination, ports and terminals can help ensure charging infrastructure is developed in locations that support efficient truck operations today while accommodating future growth in electric drayage.

Table 4. Charging Readiness and Infrastructure Planning Solutions

Solution	Description
Plan for future charging infrastructure	Incorporate charging into long-term port and terminal development plans to ensure suitable land remains available as electric drayage volumes grow. Consider how charging locations align with truck movements, terminal operations, and freight corridors. Depending on the port, this may include charging within the port, at nearby truck parking facilities, logistics hubs, or dedicated charging hubs serving the wider port area.
Coordinate infrastructure planning across stakeholders	Work with utilities, charging providers, terminal operators, trucking companies, and public authorities to align charging deployment with expected vehicle demand and operational requirements. Early coordination can help ensure charging infrastructure is delivered where it best supports port operations and future electric drayage demand.

The *Port of Rotterdam*, together with WattHub, a charge point operator in the Netherlands, has developed one of Europe's largest public charging hubs for heavy-duty vehicles within the port area. Delivered in phases, the project demonstrates how long-term planning and collaboration between the port, charging providers and logistics stakeholders can create charging capacity that supports the growth of electric drayage while remaining accessible to multiple users.

Within the San Pedro Bay port complex in Southern California, there is a growing network of public charging hubs servicing drayage for the *Ports of Los Angeles and Long Beach*. Rather than locating charging within individual terminals, this approach demonstrates how strategically located charging hubs around the port can support drayage operations while providing flexibility for carriers operating across multiple terminals.

That infrastructure needs to be built based on the ecosystem demand rather and future uptake rather than one case at a time is also recognized by *Huskey Terminal* in the *Port of Tacoma*. Their constraint is not power but making sure customer can afford their charging. Being able to tap into the funds and work with main stakeholders is key to achieve affordable charging at the terminal.

> *"The hurdle is the downstream infrastructure a large fleet transition needs. The utilities will be built, but the cost lands on the customer, and that added capex is what makes the business case harder. We are working with the Northwest Seaport Alliance and the Port of Tacoma on how that infrastructure gets planned and funded across the port rather than one customer at a time."*
>
> **— Ryan Lucido, Director Sustainability & Terminal Services at Huskey Terminal**

Shenzhen Yantian Port developed a chassis battery-swapping model, with three battery-swapping stations serving more than 250 electric heavy-duty trucks and enabling each swap to be completed in around five minutes. By locating dedicated swapping infrastructure close to port trucking activity, the model reduces vehicle downtime and helps maintain the high utilization required for port drayage.

Implementation Insights

- **Consider charging as part of long-term port planning.** Decisions relating to land allocation, terminal development, and grid capacity and expansion can significantly influence future charging opportunities, even where infrastructure is delivered by third parties.
- **Align charging locations with truck movement patterns.** Charging infrastructure is most effective when located where trucks naturally spend time, reducing unnecessary detours and supporting productive vehicle utilization.
- **Engage stakeholders early.** Early coordination with utilities, charging providers and trucking companies helps ensure infrastructure investments reflect operational requirements and future demand.
- **Recognize that ports play an enabling role.** While ports and terminals may not own or operate charging infrastructure, they are often well positioned to facilitate deployment through planning, coordination and stakeholder engagement.

3.4 Pricing and Incentive Mechanisms

Operational improvements can significantly improve electric truck utilization, but they may not fully close the total cost of ownership (TCO) gap between electric and diesel trucks. Pricing and incentive mechanisms provide ports and terminals with an additional lever to encourage electric drayage adoption by reducing financial barriers for early adopters while reinforcing broader decarbonization objectives.

Table 5. Pricing and Incentive Solutions

Solution	Description
Differential terminal pricing	Introduce reduced gate fees, terminal charges, or other financial incentives for electric trucks. Differential pricing can help offset higher operating costs during the early stages of electric drayage adoption while encouraging greater utilization of zero-emission vehicles.
Provide financial incentives	Offer financial support for electric truck movements, such as per-visit incentives, rebates, or credits. While these mechanisms are unlikely to close the TCO gap on their own, they can encourage early adoption, reduce financial risk for carriers, and strengthen the business case for fleet electrification.

DP World in the UK at its London Gateway and Southampton terminals, provides a financial incentive for electric heavy-duty trucks and applies higher charges to diesel trucks. The tariffs demonstrate how commercial mechanisms can encourage lower-emission freight movements while providing a direct financial benefit to early adopters.

An emerging opportunity is to integrate financial incentives into existing operational processes. For example, appointment systems could offer additional booking flexibility, reduced fees, or other financial benefits for electric trucks, encouraging both early adoption and operational behaviors that improve truck utilization. Building on existing operational systems can minimize implementation effort while allowing commercial incentives to evolve as electric truck volumes increase.

Implementation Insights

- **Use pricing to complement operational improvements.** Commercial incentives are most effective when combined with measures that improve operations, yard/stack optimization, truck utilization, such as efficient gate operations, predictable truck movements, and reliable charging access.
- **Design incentives that support early adoption.** Financial mechanisms should help reduce investment risk during the early stages of fleet electrification while remaining commercially sustainable as electric truck volumes increase.
- **Provide transparent and predictable incentives.** Clearly communicated eligibility criteria, incentive values, and program duration help carriers incorporate financial incentives into fleet investment and operational planning.
- **Regularly review incentive programs.** As electric drayage adoption grows, pricing mechanisms should be evaluated to ensure they continue supporting fleet transition while maintaining fair and efficient terminal operations.

3.5 Enabling Implementation Through Ecosystem Coordination

No single organization controls all the factors required to successfully deploy electric drayage. Vehicle procurement, charging infrastructure, terminal operations, freight demand, utility planning, and public policy are distributed across multiple stakeholders. As a result, ports and terminals are well positioned to convene partners, align priorities, and help coordinate deployment across the wider freight ecosystem.

Table 6. Ecosystem Coordination Solutions

Solution	Description
Establish cross-sector working groups and partnerships	Bring together terminal operators, carriers, cargo owners, charging providers, utilities, and public authorities to identify barriers, coordinate investments, and align implementation priorities.
Develop a shared action plan	Work with ecosystem partners to identify priority actions, assign responsibilities, and align operational improvements, infrastructure planning, and fleet deployment over time.

The Electrifying Drayage Alliance (EDA) is an example of a collaborative approach to accelerating electric drayage. Led by Smart Freight Centre, and supported by The Climate Pledge, the EDA brings together ports, terminal operators, trucking companies, cargo owners, charging providers, utilities, and other stakeholders to identify shared challenges, exchange practical experience, and develop solutions that can be adapted across different port environments.

Successful electric drayage deployment depends on structured collaboration across the freight ecosystem. Similar initiatives are emerging globally, demonstrating that ecosystem coordination is becoming a core implementation function rather than optional activity. Whether led by a port authority, terminal operator, industry association, or independent organization, these partnerships help align stakeholders around shared objectives and accelerate implementation.

Implementation Insights

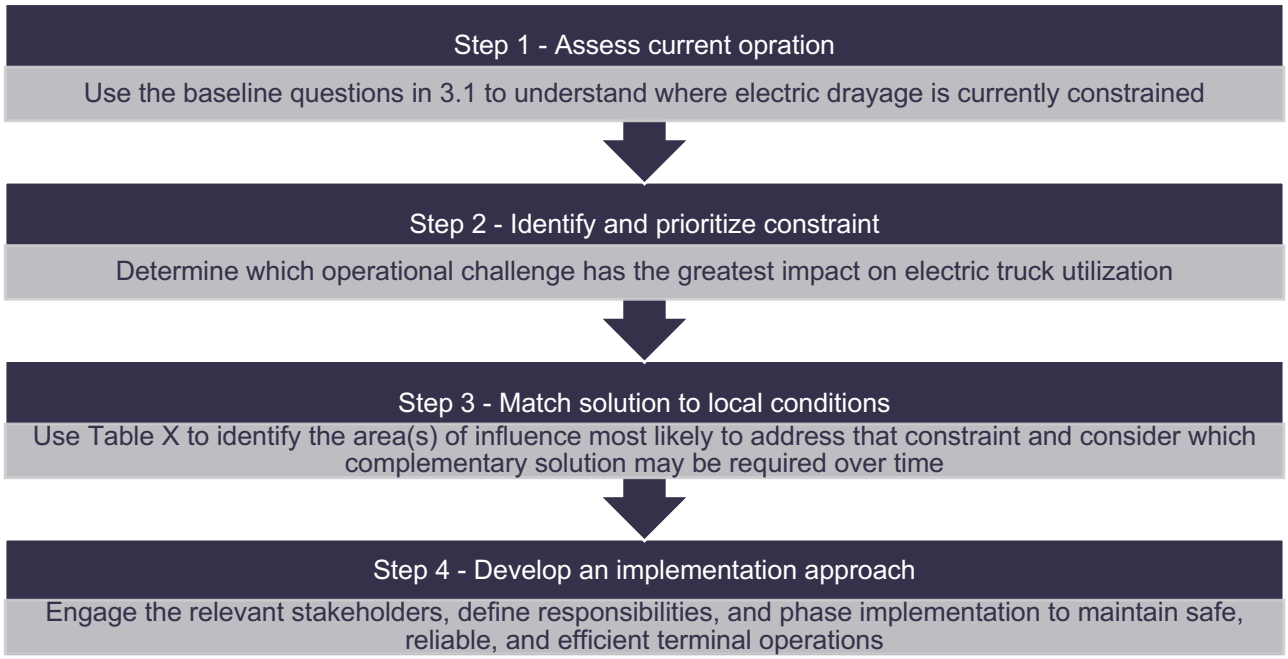
- **Recognize that responsibilities are shared.** Successful deployment depends on coordinated action across the freight ecosystem, with different stakeholders contributing expertise, investment, and operational capabilities.
- **Identify a trusted convener where needed.** Not every port or terminal has the capacity to coordinate a broad stakeholder network. Partnering with an independent organization, industry association, or other trusted facilitator can help bring together the right stakeholders, maintain momentum, and support implementation.
- **Treat ecosystem coordination as an ongoing process.** Regular engagement enables stakeholders to respond to changing operational needs, infrastructure requirements, and electric truck deployment over time.

The solutions presented in this Chapter demonstrate that ports and terminals have a range of practical levers to support electric drayage, but there is no one-size-fits-all approach. The most effective strategies will depend on local operating conditions, existing infrastructure, stakeholder priorities, and long-term electrification goals. In practice, successful implementation will typically require a combination of operational improvements, infrastructure planning, commercial mechanisms, and ecosystem coordination tailored to local needs and challenges. Most importantly, when commitments are made they must be supported and followed through; benefits are only realized when the investments are fully committed to.

4. Port and Terminal Conditions for Electric Drayage

Before selecting which measures to pursue, ports and terminals should first assess their local operating context to identify where interventions are likely to have the greatest impact. This chapter provides a practical framework for assessing local conditions, identifying operational constraints, matching solutions to local needs, and translating these into an implementation approach. Establishing a baseline of current operations provides the foundation for understanding where improvements are most likely to support electric drayage deployment.

Figure 2. Assessment Approach



4.1 Establish a Baseline

Understanding current operations is the starting point for identifying the operational constraints that most affect electric drayage. The questions below are intended to support a structured discussion among port and terminal stakeholders and help establish a shared understanding of current conditions before prioritizing solutions.

Table 7. Local Condition Assessment

Area of Influence	Key Questions	What to Look For
Operational Planning and Digital Coordination	Are truck arrivals predictable?	If truck arrivals are highly variable, appointment systems and improved operational information sharing may deliver significant value.
	Does the appointment system support efficient truck utilization?	Look for opportunities to improve vehicle utilization through booking incentives or better coordination.
	Can existing booking systems be adapted to better support electric trucks?	Existing systems may be able to support electric drayage without requiring entirely new platforms.

	How frequently do electric trucks currently call at the terminal (or are expected to in the near future)?	Electric truck activity is limited, emerging, growing, or becoming a regular part of terminal operations.
Gate Operations	How often is there traffic congestion at the gates?	Frequent congestion may indicate opportunities to improve truck flow through priority handling or other gate management measures.
	Where do trucks experience the longest delays?	Identify whether delays occur before reaching the gate, during gate processing, or while waiting for container handling to understand where interventions are most likely to improve utilization.
	Is it possible to allocate priority spots for electric trucks to load/unload containers, closer to the entrance/exit?	Consider whether terminal layout and operations allow electric trucks to reduce internal travel distances and minimize non-productive time without affecting overall terminal performance.
	Does the terminal operating system have a job prioritization function we can leverage for electric trucks? If not, can we develop one?	Assess whether existing digital systems can be adapted to prioritize electric trucks without requiring significant operational changes or new platforms.
Charging	Is charging or swapping available where trucks naturally dwell?	Charging is most effective when aligned with existing truck movements and dwell periods.
	What is the current charging dwell time?	
	Is current charging capacity aligned with expected electric truck growth?	Existing charging capacity meets expected demand, or future charging requirements are likely to constrain electric truck operations.
	Has land been designated or otherwise safeguarded for future charging expansion?	Early planning can reduce future deployment constraints.
Pricing and Incentive Mechanisms	Do existing pricing mechanisms encourage efficient operational behavior?	Consider whether incentives could improve both vehicle utilization and terminal performance.
	Are carriers indicating that commercial barriers are limiting further electric truck deployment?	Commercial barriers are emerging as adoption grows. Assess whether pricing mechanisms could strengthen the business case for carriers.
Enabling Implementation Through Ecosystem Coordination	Which stakeholders influence electric drayage in your port?	Identify organizations whose decisions affect implementation success.
	Are there existing partnerships that could support implementation?	Build on existing initiatives before creating new ones.
	Who should be involved in developing a shared action plan?	Include both operational and commercial stakeholders early in the process.

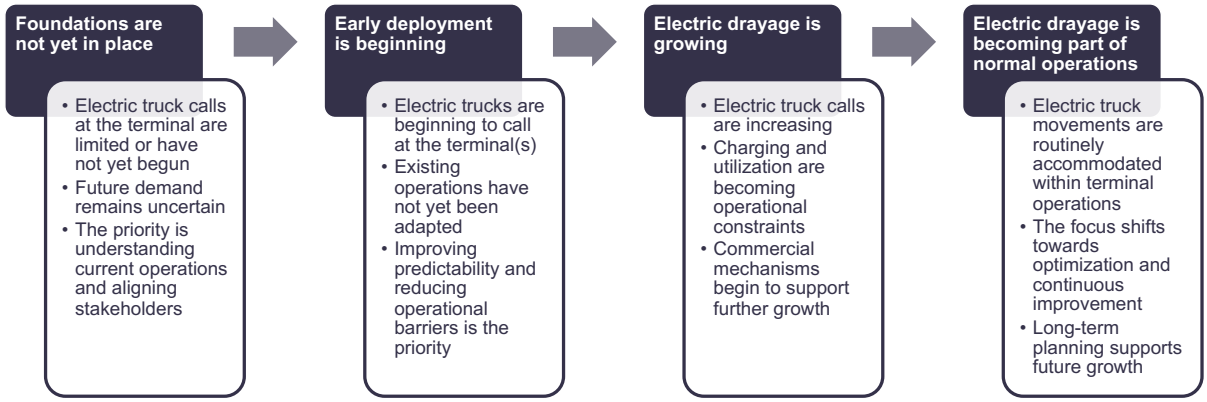
The baseline assessment is intended to identify patterns. Individual answers should not be viewed in isolation; instead, ports and terminals should consider how operational constraints combine to influence electric drayage within their local context.

This assessment is best undertaken through a cross-functional workshop involving operational, commercial, planning, and sustainability teams, together with external stakeholders where appropriate.

4.2 Classify Your Electric Drayage Operating Context

The baseline assessment provides an understanding of current operations and the conditions affecting electric drayage. By reviewing the findings collectively, ports and terminals can determine which operating context best reflects their current situation. **Figure 3** describes four typical operating contexts, based on the maturity of electric truck deployment and the operational conditions identified during the baseline assessment. The descriptions are intended as indicators rather than strict criteria, recognizing that ports and terminals may exhibit characteristics of more than one context. The operating context that most closely aligns with current conditions should be used to guide the selection and prioritization of solutions in Section 4.3.

Figure 3. Operating Context



4.3 Matching Solutions to Local Context

Once the operating context has been identified, ports and terminals can begin prioritizing the solutions most likely to deliver value under their current conditions. **Table 8** provides an indicative sequence of solutions for each operating context, recognizing that implementation should always reflect local circumstances, operational priorities, and stakeholder readiness.

Table 8. Solution Implementation at Local Condition

Electric Drayage Operating Context	Recommended Solutions to Implement	Then Consider
Foundations are not yet in place	Establish cross-sector working groups and partnerships, Develop a shared action plan	Appointment systems, Operational information sharing

Early deployment is beginning	Appointment systems, Operational information sharing, Virtual green lane / TOS-based prioritization	Priority gate processing (or Physical green lane, where operationally feasible), Plan for future charging infrastructure
Electric drayage is growing	Plan for future charging infrastructure, Coordinate infrastructure planning across stakeholders, Provide financial incentives	Differential terminal pricing, Priority gate processing (or Physical green lane, where operationally feasible)
Electric drayage is becoming part of normal operations	Differential terminal pricing, Provide financial incentives, Develop a shared action plan	Review and refine all implemented solutions to continuously improve truck utilization, operational performance, and electric drayage adoption.

Assessment should be viewed as an ongoing process. As electric drayage deployment matures, ports and terminals should periodically review operational performance, adapt implementation measures, and refine priorities based on changing market conditions.

This process will ensure that strategies remain effective at improving utilization as electric drayage continues to scale.

5. Delivering Electric Drayage at Scale

Following the assessment of local conditions and the identification of an appropriate operating context in Chapter 4, ports and terminals can begin translating priorities into an implementation plan. The appropriate pathway will vary by location, depending on operational maturity, governance structures, infrastructure readiness, and stakeholder alignment. Rather than applying a standardized implementation pathway, electric drayage deployment should be delivered through locally defined action plans that reflect both the operating context and the priorities identified throughout the assessment process.

5.1 Developing an Implementation Plan

The recommended solutions identified in Chapter 4 provide a starting point for implementation. The next step is to translate these priorities into a practical action plan that defines responsibilities, sequencing, timelines, and resources required for delivery.

Local action planning typically involves:

- Selecting the recommended solutions that best reflect local operating conditions.
- Sequencing implementation to build on existing operational practices before introducing more complex interventions.
- Establishing clear ownership across relevant stakeholders.
- Aligning operational, infrastructure, commercial, and coordination activities within a phased implementation plan.

The objective is not to implement individual solutions in isolation, but to deliver a coordinated package of measures that can evolve as electric drayage deployment matures.

5.2 Collaborative Execution

Successful implementation depends on coordinated action across the port ecosystem, including terminal operators, carriers, ports, energy providers, public authorities, and technology partners. These elements are interconnected, and progress in one area is often constrained by readiness in others.

Effective execution of the implementation plan depends on:

- Clear definition of roles and responsibilities across the ecosystem
- Alignment between operational and infrastructure planning
- Shared understanding of deployment timelines and constraints
- Ongoing coordination as deployment scales and operational conditions evolve

No single stakeholder can enable electric drayage independently. Progress depends on coordinated action across the port ecosystem.

5.3 The Role of the Electrifying Drayage Alliance (EDA)

The Electrifying Drayage Alliance (EDA) supports coordination across port ecosystems as they move toward large-scale deployment of electric drayage.

This includes:

- Supporting ports and terminals in translating assessments and recommended solutions into coordinated implementation plans.
- Facilitating alignment across stakeholders within port ecosystems
- Providing access to shared learning from other port deployments
- Helping identify sequencing approaches tailored to local conditions

The aim is not to prescribe a single model for implementation, but to help ports and terminals develop practical implementation plans that reflect their operating context, stakeholder landscape, and long-term electrification ambitions. Electric drayage deployment will not follow a uniform pathway. Success depends on selecting the right combination of solutions, implementing them in a coordinated manner, and adapting them as deployment continues to mature.

By coordinating stakeholders, reducing operational barriers, and aligning infrastructure and commercial decisions, ports and terminals can play a pivotal role in accelerating the transition to electric drayage while maintaining safe, efficient and resilient freight operations.

References

[i] International Transport Forum (2021). ITF Transport Outlook 2021. Paris: OECD Publishing

[ii] Tinnes, E., Perez, F. and Kandel, M., (2024) *Decarbonizing logistics: Charting the path ahead*. McKinsey & Company

[iii] Greenhouse Gas Protocol (2026) *Scope 3 Standard Revisions: Phase 1 Progress Update*. March 2026. Available at: Scope 3 Standard Revisions: Phase 1 Progress Update

[iv] ECT Hutchison Ports (n.d.) *Road services*. Available at: ECT Road Services

[v] DTNext (2025) 'Chennai police bar heavy vehicles, LMVs on key city roads to ease congestion', *DTNext*, 14 April. Available at: DTNext article

[vi] APM Terminals (n.d.) *Clean Truck Express Lane*. Available at: APM Terminals – Clean Truck Express Lane

[vii] APM Terminals (2025) *Fully automated priority for electric trucks*. APM Terminals Gothenburg, 26 September. Available at: APM Terminals Gothenburg – Fully Automated Priority for Electric Trucks