Accelerating Port Electrification with Off-Grid Mobile Power:

A Renewable Propane Pathway for Heavy-Duty EV Charging Infrastructure

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Case Study Location: Port of Long Beach, California
Operator: Yusen Terminals LLC


Executive Summary

Global supply chains are undergoing rapid electrification, particularly in port environments where regulatory mandates and environmental pressures are accelerating the transition to zero-emission cargo handling equipment. However, **grid infrastructure constraints remain the primary bottleneck** to deployment.

This white paper presents a case study demonstrating how **off-grid, mobile power generation systems**, fueled by **propane and renewable propane**, can:

- Enable **rapid deployment (<30 days)** of EV charging infrastructure
- Deliver **lower lifecycle carbon intensity (CI ~25)** compared to California grid averages (~80 or greater)
- Provide **economically viable and scalable solutions** for heavy-duty electrification

The findings suggest that **distributed, off-grid energy systems can serve as both transitional and long-term infrastructure solutions** in constrained environments.

1. Introduction

Port electrification is a cornerstone of decarbonization strategies in freight transportation. Regulatory frameworks such as those implemented in California require rapid adoption of zero-emission equipment, including:

- Electric yard tractors (Class 8)
- Electric top handlers and reach stackers

Despite technology readiness, infrastructure deployment remains constrained by:

- Utility interconnection delays (18–36 months)
- Limited grid capacity
- High capital costs for permanent installations

This paper evaluates an alternative model: **deployable, off-grid charging infrastructure decoupled from utility timelines**.

2. Background and Literature Context

2.1 Grid Constraints in Port Electrification

Prior studies and industry reports highlight:

- Increasing load demand from electrified fleets
- Long lead times for substation upgrades
- Congestion in urban transmission networks

2.2 Distributed Energy Systems

Distributed and modular energy systems are emerging as viable alternatives, offering:

- Faster deployment
- Reduced reliance on centralized infrastructure

3. Methodology

This case study uses a **scenario-based modeling approach** informed by:

- Real-world deployment parameters from port operations
- Carbon intensity (CI) benchmarking using standardized lifecycle metrics
- Economic modeling based on Charge-as-a-Service (CaaS) structures
- LCFS (Low Carbon Fuel Standard) credit valuation frameworks

Key Variables Modeled

- Energy demand (MWh/year)
- Carbon intensity differentials (gCO_2e/MJ)
- Capital and operating costs
- Deployment timelines

5. Case Study Deployment

Site Context

- **Location:** Port of Long Beach, California
- **Operator:** Yusen Terminals LLC

Deployment Parameters

Parameter	Value
Number of Units	4
Total Capacity	2.0 MW
Charging Power	150–350 kW
Fleet Supported	40–60 trucks + 6–10 top handlers

Deployment Timeline

Phase	Duration
Assessment	~1 week
Mobilization	~2 weeks
Installation	<1 week

Total Time: <30 days

6. Environmental Analysis

6.1 Carbon Intensity Comparison

Energy Source	CI (gCO_2e/MJ)
Renewable Propane	**~25**
California Grid Average	~80

6.2 Emissions Reduction Insight

Renewable propane-based systems can achieve **substantially lower lifecycle emissions than grid-supplied electricity**, particularly when grid power is derived from marginal fossil generation.

6.3 Policy Alignment

- Supports **Low Carbon Fuel Standard (LCFS)** frameworks
- Enables **quantifiable emissions reductions**
- Aligns with state and port-level decarbonization mandates

7. Economic Analysis

7.1 Revenue Model

Component	Annual Value
Charging Revenue	~$720,000
LCFS Carbon Revenue	~$121,500
Total Revenue	**~$841,500**

7.2 Financial Performance

Metric	Value
CapEx per Unit	$150,000
Payback Period	~12 months
EBITDA Margin	45–60%

7.3 Carbon Monetization

LCFS credits convert emissions reductions into revenue, improving:

- Project IRR (+400–800 bps)
- Debt service coverage
- Portfolio valuation

8. Discussion

8.1 Infrastructure Paradigm Shift

This case illustrates a shift from:

- **Centralized, grid-dependent systems**
  to
- **Distributed, deployable energy infrastructure**

8.2 Transitional vs Permanent Role

Off-grid systems may function as:

- Near-term deployment solutions
- Long-term infrastructure in constrained environments
- Supplemental capacity alongside grid-connected systems

8.3 Limitations

- Fuel logistics must be managed effectively
- LCFS pricing volatility introduces revenue variability
- Site-specific operational constraints may apply

9. Broader Implications

The model is transferable to:

- Seaports nationwide
- Rail and intermodal facilities
- Airport ground operations
- Warehouse and logistics hubs

10. Conclusion

This study demonstrates that:

- **Grid constraints—not technology—are the primary barrier to electrification**
- Off-grid mobile power enables immediate deployment
- Renewable propane provides a **low-carbon, scalable energy solution**

Distributed energy systems can accelerate decarbonization while improving economic outcomes and infrastructure flexibility.

11. Key Takeaways

- Deployment timelines reduced from **years to just weeks**
- Renewable propane achieves **materially lower CI than grid electricity**
- Carbon reductions can be **monetized via LCFS frameworks**
- Mobile infrastructure supports **scalable, flexible electrification**
- EnviroCharge is **"leading the charge"** for cost-effective mobile EVSE in sea and airports

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