The Opportunity to Electrify Container Transport in Nigeria

White Paper – July 2025

A pragmatic roadmap to unlock transformational benefits well beyond decarbonisation

Preface

Container transport is a vital pillar of Nigeria's economy, moving 52% of imported goods by value between ports and production hubs.[1] Its role will only grow as GDP and trade volumes are projected to rise by 15–20%[2] and 30%,[3] respectively, by 2030.

This whitepaper lays out the opportunity for Nigeria to electrify its container transport sector, including the major economic, social, and climate benefits that could be unlocked if action is taken now.

Today, most containers transit through the ports of Apapa, Tin Can Island, and Lekki in Lagos State and Onne, Rivers State, collectively accounting for 98% of Nigeria's containerised trade,[4] and are hauled inland by trucks, which move 90% of containers, compared to 3% by rail and 7% by barge.[5] **This paper focuses on the two dominant container transport modes** by volume: **container handling in ports** and **container trucking inland.**

[1] Nigerian Bureau of Statistics
[2] The World Bank (2025), *Nigeria Development Update: Building Momentum for Inclusive Growth*
[3] The Guardian Nigeria (2024), *NPA projects 30% growth in trade volume by 2030*
[4] Systemiq analysis based on APMT data, assuming the following container traffic in 2024 (TEUs): Apapa (450,519), Tin Can (474,000), Lekki (239,522), Onne (121,175), Others (30,479)
[5] The Guardian Nigeria (2025), *Barge, Rail Options Cut Haulage Costs amid Efficiency Concerns*

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Executive summary

An opportunity to leapfrog electrifying Nigeria's container transport sector

Nigeria has a rare opportunity to electrify container transport at a scale never seen before in West Africa - leapfrogging fossil-powered infrastructure to align with a fast-growing global shift.

Across the world, ports and container transport corridors are increasingly electrifying. Over 40 ports - including in Aqaba (Jordan), Suape (Brazil), and Abidjan (Côte d'Ivoire) - are deploying electric container handling equipment, investing in clean energy, and digitising logistics systems. On land, electric trucking corridors are emerging along high-volume routes, with promising initiatives in Kenya, China and India demonstrating that container transport electrification is increasingly viable in emerging market settings.

Among West African nations, Nigeria is uniquely positioned to lead the charge on this shift. It handles the lion's share of the region's imported cargo (70%)[6] and has the largest economy, population and industrial base, making it a natural anchor for low-carbon logistics.

While a phased approach to replacing fossil fuels can be necessary in some instances, the **Nigerian container transport sector offers a major opportunity to leapfrog incremental technologies,** such as diesel upgrades or gas-powered equipment, and avoid costly lock-in in a context of falling battery and solar prices. This can also drive public and private investments towards significantly upgrading Nigeria's power grid infrastructure, especially transmission and distribution.

Electrifying container transport can unlock major economic, social and climate benefits for Nigeria within the next 5 years, including:

- **Investments:** this transition could mobilise ₦1.3 trillion (~US$830 million) in new investments across container transport equipment, grid upgrades, and energy generation.
- **Local community benefits:** communities stand to benefit from further improvements to local grids, reduced air pollution and therefore potential economic savings of ₦33 billion (~US$20 million) per year from reduced air pollution mortality, and a shift towards better-paid, higher-skilled jobs in logistics and energy services, as maintenance needs evolve from older, mechanical systems to more sophisticated, electrical replacements.
- **Greenhouse gas (GHG) emission reductions:** replacing diesel engines with more efficient electric alternatives could abate 80 $ktCO_2e$ per annum by 2030, directly supporting Nigeria's Nationally Determined Contribution (NDC) to the Paris Agreement.
- **Knock-on effects:** electrification could also deliver wider knock-on effects, including increased trade from a more cost-competitive container transport sector, reduced economic losses through improved power reliability, and greater access to international financing.

The time to act is now – electrification aligns with upcoming investment cycles and can drive progress on key national priorities.

- Several terminal concessions are due for renewal,[8] creating a rare opportunity to embed electrification into the next wave of port and logistical investment. This transition can also help deliver on several national strategic priorities, including the Energy Transition Plan (by shifting away from diesel), the National Development Plan (by unlocking industrial growth), and the Human Capital Development 2.0 (HCD 2.0) strategy (by creating more skilled, higher-value jobs).

[6] Region being West and Central Africa. Source: Nigerian Ports Authority (2021), *Nigeria Poised to Become Africa's Maritime Hub - NPA MD*
[7] Systemiq analysis based on expert interviews. N1,300 trillion is approximately equivalent to ~US$800 million as of June 2025
[8] Systemiq analysis based on Shipping Position Daily (2024), *Stakeholders Await Renewal As Eight Out of 27 Port Concessions Expire*

1.
Electrified container transport is increasingly outcompeting diesel

Rapidly improving economics and enhanced performance are tipping the balance towards electrified container transport.

With battery prices having declined by 80% over the last decade,[9] **electric container handling equipment (e-CHE) is becoming increasingly cost competitive** on a capital expenditure (CAPEX) basis, significantly narrowing the upfront cost gap with diesel alternatives.[10] The continuation of battery price declines in the coming years is expected to **enable electric trucks to achieve price parity with diesel by 2030.**[11] In China, where manufacturing scale is the largest to date, price parity is expected even sooner, leading industry experts to anticipate that electric trucks could account for 50% of new heavy truck sales by 2028.[12] By being proactively opportunistic, **Nigeria can tap into these price declines** to electrify its container transport sector at low cost.

Even in oil- and gas-rich economies like Nigeria, operating costs for electrified equipment are lower than for diesel alternatives. This is due to two driving factors: lower energy costs and lower maintenance & repair costs. **Energy costs are lower** because (i) electric drivetrains are around three times more energy-efficient than combustion engines, and (ii) electricity, especially when generated from renewables, is now a far more affordable and stable energy carrier than diesel or gas.[13] On a headline basis, in Nigeria, 1 kWh of solar electricity (₦100) is about 3 to 4 times less expensive than the diesel energy equivalent (₦350-400).[14] While the actual cost gap narrows once factors like delivery losses, generator inefficiencies, and informal charges are considered, diesel remains structurally more volatile, with prices tripling after the 2023 fuel subsidy removal. In contrast, renewable power purchase agreements (PPAs) offer price stability and long-term cost predictability. Although solar generation is intermittent and requires grid connections, storage or backup solutions, its lifetime energy cost remains lower and more stable than diesel. **Maintenance and repair costs are also lower:** on average by 25-50%, and up to 60-70% for the most mature e-CHE, thanks to fewer moving parts, simpler servicing and reduced downtime.[15] Therefore, even in an oil-rich country like Nigeria, a shift away from diesel use at container terminals would help make port operations more resilient and, moreover, ensure that its fossil resources are used domestically only where economically competitive while the rest is exported for international markets, delivering optimal dividend from oil and gas while maintaining a competitive port and logistics centre within Nigeria.

While hydrogen- or gas-powered container transport equipment may be appropriate in some limited contexts, **there is a growing consensus that electrification offers the best path forward.** For example, hydrogen CHE can be relevant in very cold environments where battery performance degrades. However, it comes with structurally higher costs due to its low energy efficiency, requiring 3 to 4 times more electricity than e-CHE for the same output, and the need for complex fuelling infrastructure.[16] Similarly, gas-powered trucks can make sense, especially for short, repetitive routes, when they can tap into an existing, efficient gas distribution network. Nonetheless, they expose operators to the same energy cost risks seen with diesel due to the global fossil fuel market volatility, while delivering only marginal emission reductions compared to diesel (-6% on average).[17]

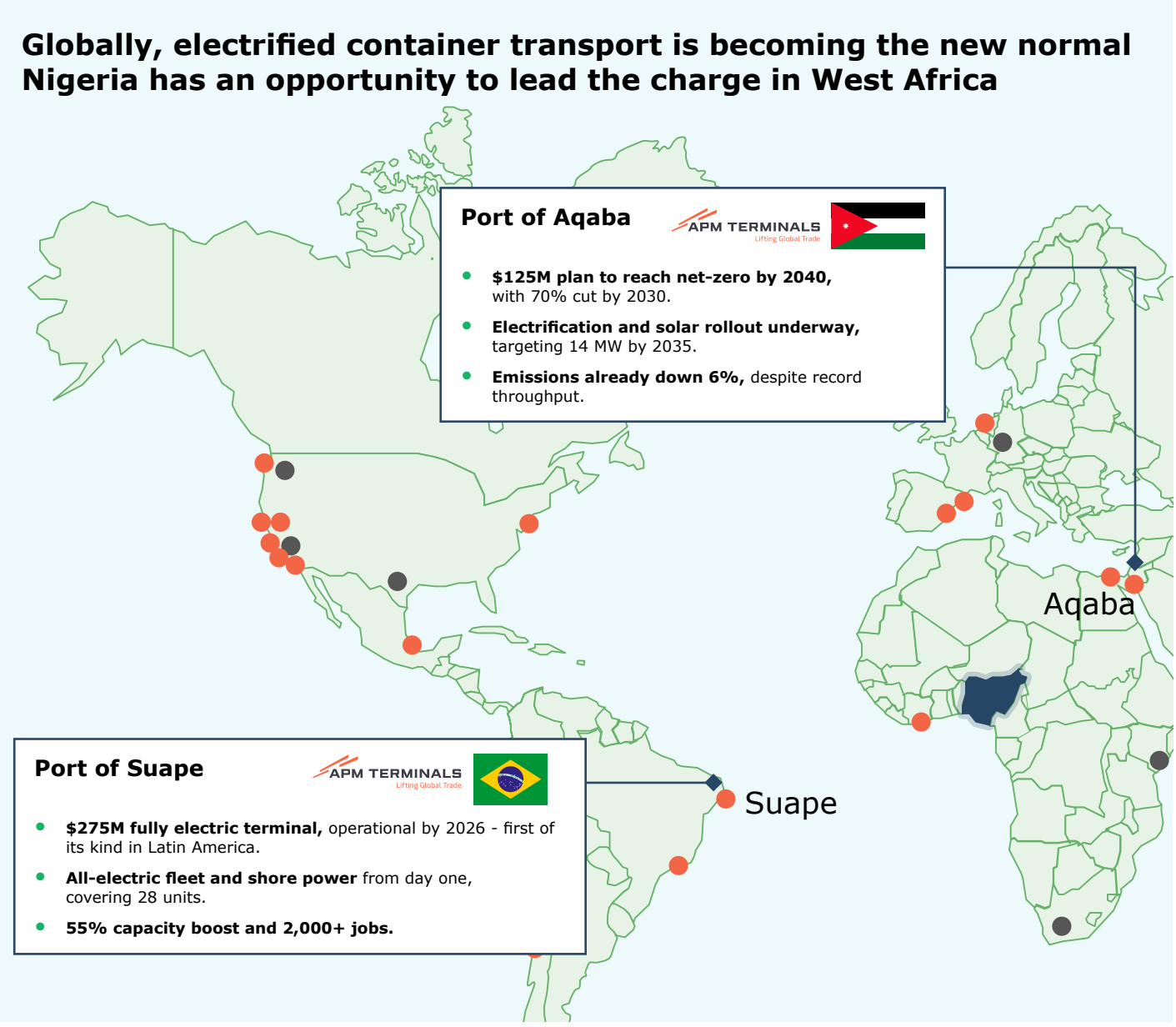
[9] BloombergNEF (2024), *Lithium-Ion Battery Pack Prices See Largest Drop Since 2017, Falling to $115 per Kilowatt-Hour*
[10] Systemiq analysis based on expert interviews
[11] BNEF (2024), *Zero-Emission Commercial Vehicles: the Time is Now – A Factbook for Investors*
[12] Financial Times (05/2025), *CATL founder Robin Zeng expects China truck market to be 50% electric by 2028*
[13] This efficiency factor (2.6 kWh/L) is based on ADE methodology, assuming a diesel energy content of 10.5 kWh per litre and an internal combustion engine efficiency of 25%
[14] Assuming ₦1200/litre and a 35% engine efficiency for diesel generators
[15] Expert interviews
[16] APM Terminals and DP World (2023), *Reaching a tipping point in Battery-Electric Container Handling Equipment*
[17] Trucks powered by natural gas tend to have high nitrogen oxide and greenhouse gas emissions from combustion and methane leakage. Natural gas trucks have also been found to only provide marginal improvements compared with diesel trucks in terms of greenhouse gas and pollutant emissions. Sources: Gonca Seber Olcay (International Council on Clean Transportation, 2025), *How Upstream Methane Leakage Further Weakens the Argument for Natural Gas Trucks;* Moritz Mottschall, Peter Kasten, and Felipe Rodriguez (International Council on Clean Transportation, 2020), *Decarbonization of On-Road Freight Transport and the Role of LNG from a German Perspective.*

Electrified container transport is a proven technology - it is already scaling in ports and gaining traction in inland trucking corridors, including in emerging markets.

In ports, electric equipment with a cabled power connection[18] has been standard in new terminals for over a decade. Battery-electric vehicles like terminal tractors are also moving from pilots to full deployment, with many examples in developing contexts. In Brazil's Port of Suape, a new all-electric terminal is under construction,[19] Côte d'Ivoire Terminal in Abidjan became operational in late 2022 as fully electric,[20] and Jordan's Port of Aqaba is rolling out electric handling equipment.[21]

On land, electric trucking pilots are emerging along high-volume corridors, where three conditions tend to be met: (i) route patterns are regular and distances manageable

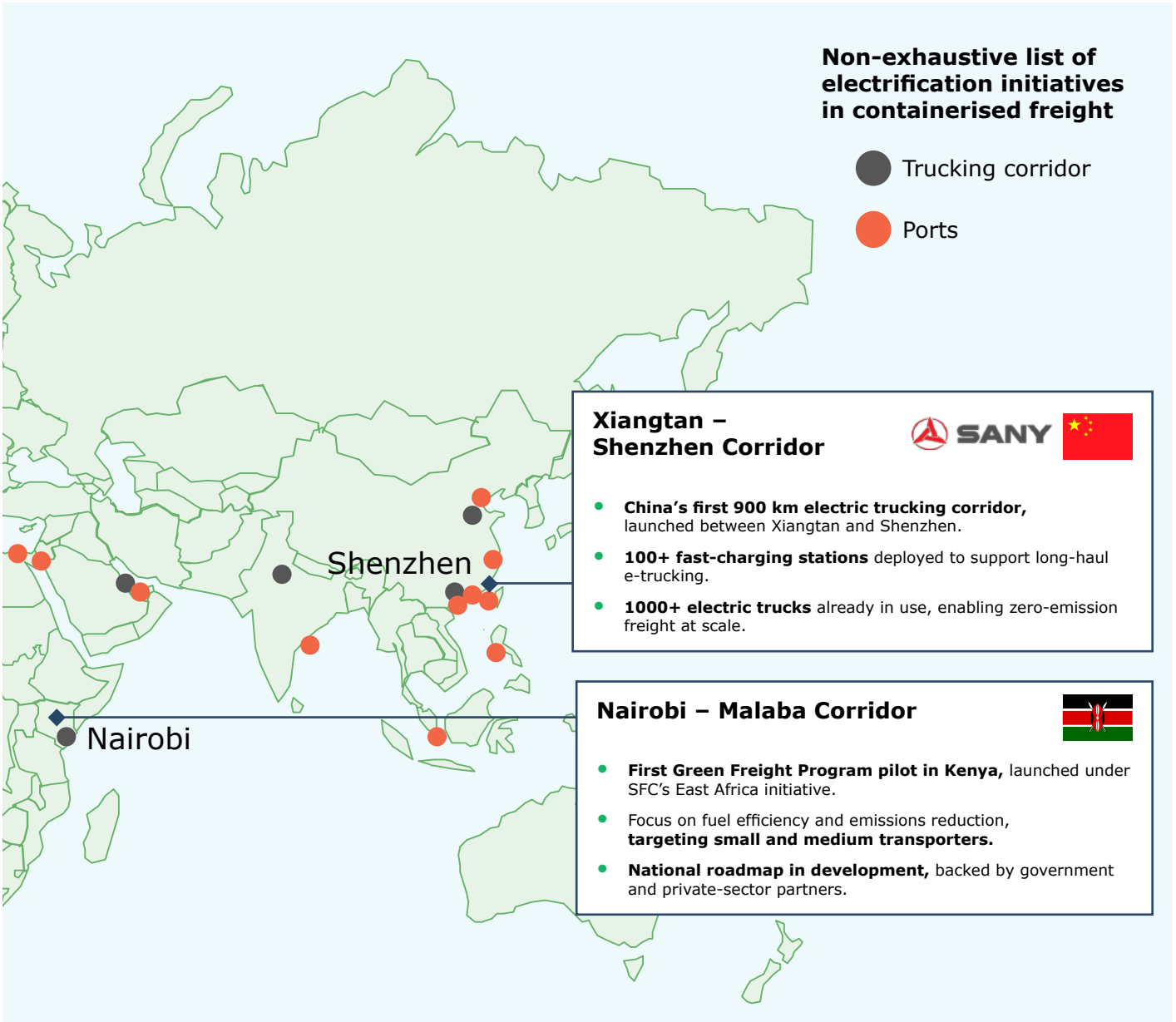
Exhibit 1. Overview of container transport electrification initiatives unfolding worldwide (non-exhaustive)



Source: Systemiq analysis based on publicly available data

[18] Equipment with a cabled power connection, also known as tethered CHE, can either be stationary (e.g., ship-to-shore cranes) or operate in predictable, limited movements (e.g., rubber tyre gantry cranes). These are typically used for container handling from ship to shore or for yard stacking operations. Equipment that does not have a cable but rather run on batteries and can move freely are called untethered CHE and is typically used for bidirectional quay-to-yard moves (e.g., terminal tractors) or to perform terminal housekeeping (e.g., reach stackers).
[19] APM Terminals (2024), *APM Terminals Suape Breaks Ground on Latin America's First Fully Electrified Terminal*
[20] APM Terminals (2022), New zero-emission Côte d'Ivoire Terminal receives first port equipment
[21] APM Terminals (2023), *USD60 Million electrification Pilot to Speed Up Port-Equipment Decarbonisation*

for battery range; (ii) depots or terminals have space and reliable power supply for charging; and (iii) truck utilisation is high enough to recover costs over time. These corridors also tend to benefit from the presence of large, integrated players – who can absorb pilot costs more easily – and supportive policy regimes (e.g., tax emptions, production mandates, direct subsidies). Pilots have reached a large scale in mature economies, such as China, the EU and California. However, the model is starting to spread, with promising initiatives in East Africa, Chile[22] and India[23] demonstrating that inland container transport electrification is increasingly viable in emerging market settings too.



[22] Maersk (05/2025), *Maersk and Sotraser Announce Electric Truck Operations in Chile*
[23] Times of India (05 2025), *Government identifies 10 highway segments for zero-emission truck movement, the move to help India reach its climate goals*

2.
Nigeria has a credible path towards electrifying container transport

With clear techno-economic advantages, electrification is becoming the defining feature of modern, efficient container transport – and Nigeria can lead the charge in West Africa. **There is a credible, phased path towards electrifying container transport in the country, outlined below.**

Electrification can proceed along parallel but staggered timelines, starting with a sharper focus on ports, while inland haulage scales more gradually. **Ports offer the most logical starting point:** terminals are easier to electrify thanks to their localised operations, more manageable power supply needs, and operators capable of meeting capital requirements. Ports can then anchor a broader shift across inland freight corridors, setting off a chain reaction across the wider container transport sector and beyond.

Exhibit 2. Overview of roadmap to electrify container transport in Nigeria

POWER SUPPLY: Key enabler

2025 onwards

Solutions include: maximising on-site solar + BESS1, improving grid connections, developing offsite generation tied to PPAs2

PORTS: Large-scale electrification possible today

Electrification is advantageous in all Nigerian ports, but **some present more immediate opportunities than others:**

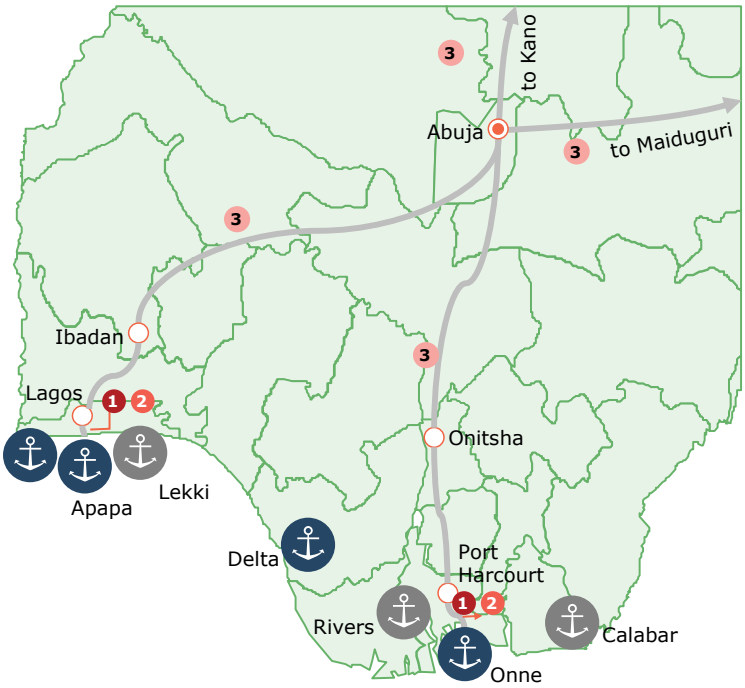
2025 onwards

- First-mover candidates: Apapa, Tin Can, Onne
- Second-mover candidates: Lekki, Rivers, Delta

TRUCKS: Phased electrification necessary

Overcoming electrification challenges will require a phased, pragmatic rollout:

- 2026-2028 — 1 — Phase 1 : Pilot deployment on 1-2 select corridors/hubs
- 2028-2032 — 2 — Phase 2: Commercial demonstration
- Mid-2030s onwards — 3 — Phase 3: National integration



Full electrification is feasible across all of Nigeria's container terminals, with some ports presenting more immediate opportunities than others.

Apapa, Tin Can Island, and Onne are clear first mover candidates, given their larger share of container flows (79%)[24] and their existing equipment being up for renewal. While some assets may not yet be at the end of their operational life, it makes sense to begin planning now for a phased transition, aligning electrification investments with natural replacement cycles. While electrification is also relevant for Lekki, its recent commissioning and modern assets make it a lower priority in the short term. Rivers and Delta ports could also benefit from electrification, but their smaller container volumes (2%) suggest a later-stage focus.

[24] Systemiq analysis based on APMT data, assuming the following container traffic in 2024 (TEUs): Apapa (450,519), Tin Can (474,000), Lekki (239,522), Onne (121,175), Others (30,479)

Unlocking full electrification in these ports hinges on securing a stable, low-cost power supply.

At Apapa and Tin Can Island, where land is constrained but grid connections are present, on-site solar installation is the most practical and cost-effective solution.[25] However, it typically meets only 10–25% of current terminal electricity needs due to space limitations.[26] To ensure a consistent power supply,[27] port operators could collaborate with the Nigerian Ports Authority (NPA), transmission and distribution network operators, and energy developers to (i) strengthen grid connectivity by auditing and upgrading distribution lines and substations within ports, and (ii) complement solar with back-up solutions (e.g., battery energy storage systems (BESS) or gas turbines). Off-site renewable electricity generation may also be required, with an opportunity to create a demand cluster by linking terminal operators with nearby industrial players.

For ports currently disconnected from the grid, such as Onne, continuing to rely on diesel generators will keep operating costs high. While on-site solar can provide some relief, its limited capacity (typically meeting only 10–25% of current terminal electricity demand) makes it insufficient on its own. To secure a reliable and cost-effective power supply, operators should pursue both grid connectivity and offsite renewable energy solutions. One promising option is to sign PPAs for offsite solar generation, ideally located in high-irradiation regions like northern Nigeria. This clean electricity could be transmitted through the national grid to the port. Doing so would not only lower energy costs but also improve the stability of the broader electricity system, especially if paired with targeted public and private investments in local transmission and distribution infrastructure. Close collaboration with NPA would be essential to secure approvals and coordinate infrastructure upgrades.

While securing a reliable power supply is underway, ports should not wait to start transitioning to electric equipment.

Even terminals like Apapa, which experience frequent outages,[28] can begin immediately with phasing in electric CHE, if they develop sufficient back-up power supply. Here, too, lower carbon and lower costs largely go hand in hand. This approach helps avoid locking in diesel assets for potentially decades to come.

- For mobile equipment, electric models can serve as drop-in replacements, with combined charging systems (CCS) already proven in comparable settings.[29]

- For equipment with a cabled power connection, electrification is a mature solution, though it may require additional civil works (e.g., trenching, cabling) and careful operational planning to minimise disruption during rollout.

With terminals electrifying, the next frontier lies beyond the port gates - electrifying the inland movement of containers across Nigeria's freight corridors, including rail and barge but especially via trucks.

Despite rapidly improving economics, truck electrification in Nigeria could initially be more challenging than port electrification. The trucking sector is highly fragmented, and dominated by small, informal operators with limited capital. New electric trucks remain more expensive than the imported second-hand diesel trucks that are currently prevalent on Nigeria's roads. Finally, charging infrastructure is missing and power supply tends to be unreliable in large parts of the country, especially beyond major urban centres. Overcoming these barriers will require a phased, pragmatic rollout - starting in targeted corridors, building on shared infrastructure, and expanding where operational conditions allow, ideally with support in the early stages from development finance to start moving while the economics continue to gradually improve. Crucially, this roadmap should be closely coordinated with port electrification efforts, particularly in terms of grid upgrades, shared charging systems, and scaling solar + battery solutions.

A three-phase roadmap can guide Nigeria's journey towards electrified container trucking and ensure full benefits are unlocked.

Phase 1 (2026–2028): Pilot deployment on 1-2 select corridors/hubs

In this phase, a pilot could be launched in one or more targeted locations, deploying ~5–20 electric trucks led by at least one anchor company (such as a major domestic player or an international logistics firm). The pilot may also involve a broader coalition of

[25] Systemiq analysis based on expert interviews. Assuming LCOEs of ₦90/kWh for on-site solar, ₦180/kWh for gas turbines, ₦190/kWh for grid electricity (Band A industrial), and ₦350/kWh for diesel generators, on-site solar is already around 50% cheaper than gas, 53% cheaper than grid power, and 74% cheaper than diesel, according to Nigerian energy developers.
[26] Indicative estimate from Nigerian terminal operators.
[27] For instance, some Nigerian ports faced outages of 6 hours or more on ~220 out of 365 days in 2024.
[28] 50-60%
[29] Combined charging systems are standardized connector types that allow for both AC and DC charging, offering a more versatile charging solution for electric vehicles.

stakeholders, such as battery OEMs, terminal operators, or public entities like the federal government, to help absorb early cost premiums and leverage existing infrastructure – advantages typically out of reach for smaller operators.[30]

The selection of these locations is a key first step and should consider the following key criteria (non-exhaustive): availability of power for charging points; predictable, repeated trucking route of distance manageable for vehicle battery lifetimes; and willingness to pay by primary cargo owners on green premium, unless concessional financing has sufficiently closed this gap. Candidates could include (i) the Port of Apapa to Lagos industrial hubs (e.g., Abule Oshu, Agbara or Ikeja), which collectively handle approximately one third of Nigeria's containerised import volumes and consists of short (<60 km), high-volume, highly repetitive route patterns, and (ii) Onne port to Port Harcourt, which may offer more available land space for new renewables power generation and also forms a predictable 'corridor'.

Phase 2 (2028-2032): Commercial demonstration

During phase 2, electric trucks are expected to become mainstream in leading markets such as China.[31] A successful pilot in Nigeria could pave the way for a ten-fold scale-up to 50-200 trucks along the same corridors/hubs selected for Phase 1. This would mark the transition from proof-of-concept to commercial deployment, signalling Nigeria's commitment to low-carbon logistics. At this stage, shared charging infrastructure will be key, focusing on two main options:

- **Call-up parking zones,** e.g., outside Apapa Port, such as Lilypond Truck Park, where trucks already queue, ensuring high utilization and efficiency.
- **Freight hotspots,** e.g., across Lagos, including key depots and logistics centres, designed to maximise charging station use and reduce costs.

Power for these hubs can come from upgraded port grid connections or on-site solar plus batteries at freight depots. To overcome financing barriers, concessional leasing and fleet-as-a-service models – supported by DFIs and truck manufacturers – can enable adoption.

Crucially, policymakers should anticipate that adoption may follow an S-curve, with faster growth than linear projections suggest. By planning ahead, Nigeria can secure first-mover advantages as technology costs decline and market demand accelerates, ensuring the country is prepared to integrate and scale up this technology rapidly as adoption takes off.

Phase 3 (Mid-2030s onwards): National integration

Following successful commercial demonstrations in key locations in phases 1-2, trucking electrification can expand to and connect with other national strategic routes in phase 3. For example, the construction of the Lagos-Abuja Super Highway – planned to fast track travel between Nigeria's commercial and political capitals – could offer a rare opportunity to expand freight electrification to other parts of the country for cargo owners willing to pay toll fees.[32] At ~470km, the new route may be short enough for most modern electric trucks to complete on 1-2 charges, thereby eliminating the need for frequent en-route charging. By 2040, further cost reductions and the emergence of a global second-hand EV market may enable mass adoption among smaller operators. The electrification readiness of Abuja would also lay the foundation for future corridor expansion - positioning it as a logistics node for electrified routes to Kano (north) and Onne/Onitsha (south-east). Deployment can build on the shared infrastructure model proven in Lagos and Abuja: solar + battery charging hubs located along key routes, supported by integrated financing solutions and embedded into national green infrastructure plans. When investing in infrastructure, Nigeria should remain technology-agnostic, considering both fixed charging stations and swappable battery models, to ensure flexibility as the market evolves. It will be critical to track developments in leading markets like Europe and China, where new technologies and business models are emerging rapidly and could shape future cost and operational advantages. To support truck availability, Nigeria's rising freight demand and regional leadership could justify local electric truck assembly, making it an attractive base for OEMs seeking to enter the West African market.

[30] A similar model is being piloted in Eastern Africa as part of the Green Freight Support Program in Eastern Africa, led by Smart Freight Centre and Kühne Climate Centre.
[31] Financial Times (05/2025), *CATL founder Robin Zeng expects China truck market to be 50% electric by 2028*
[32] While the toll fee of ₦500 per trip (set as a flat toll rate by Nigeria's Federal Tolling Policy for federal dual carriageways, including the Lagos-Abuja Super Highway) is relatively modest compared to current haulage rates - transporting a 20-foot container from Lagos to other parts of Lagos costs approximately ₦500,000, and to northern states between ₦900,000 and ₦1,000,000 - some operators might still consider alternative routes to avoid tolls. However, these alternatives often involve longer travel times, poorer road conditions, and higher risks, potentially offsetting any savings from avoiding toll fees.

While electric trucks scale, barges and rail will continue to play a complementary role. Railways and barges already complement Nigeria's trucking networks, are relatively carbon-efficient due to their higher load capacity, and can also reduce congestion, air pollution and freight times.[33] Electrification of both these inland freight transportation modes would already be technically possible: rail electrification is globally mature, while barge electrification is emerging, with examples including Vietnam's first fully electric container barge launching this year[34] and China actively transitioning its barges to electric on the Grand Canal, a major inland waterway in eastern China.[35]

[33] For instance, the Addis-Djibouti Railway cut freight transport time from three days to under eighteen hours. Source: Xinhua (2025), *Ethiopia-Djibouti Railway Pledges to Reshape Trade Dynamics, Foster Regional Development*
[34] CMA CGM (2025), *CMA CGM Launches First 100% Electric River Barge with NIKE in Vietnam*
[35] E-Hangzhou (2024), *First electric cargo ship sets sail on Hangzhou's Grand Canal*

3.
What Nigeria can gain from electrifying containerised trade

Electrifying container transport can deliver major economic, social and climate benefits for Nigeria. While achieving full system electrification may extend to 2050, tangible benefits can be realised as early as 2030 - including investments of approximately ₦1.3 trillion (~US$830 million), the avoidance of up to ₦370 billion (~US$225 million) per year in air pollution-related damages, and a reduction of around 80 $ktCO_2$ in annual GHG emissions by 2030. **This section outlines the benefits achievable by 2030,** stemming from a full electrification of port operations and the progressive adoption of electric container haulage.

Exhibit 3. Overview of benefits for Nigeria that could be unlocked by container transport electrification

Annual GHG emission reductions[1]

Full system electrification (post-2050)

390 $ktCO_2e$ — Full electrification of container handling in ports, and container haulage inland

Possible reductions by 2030[2]

80 $ktCO_2e$ — Full electrification in ports, pilot for trucking

Economic benefits

Investments (by 2030)

-US $830M

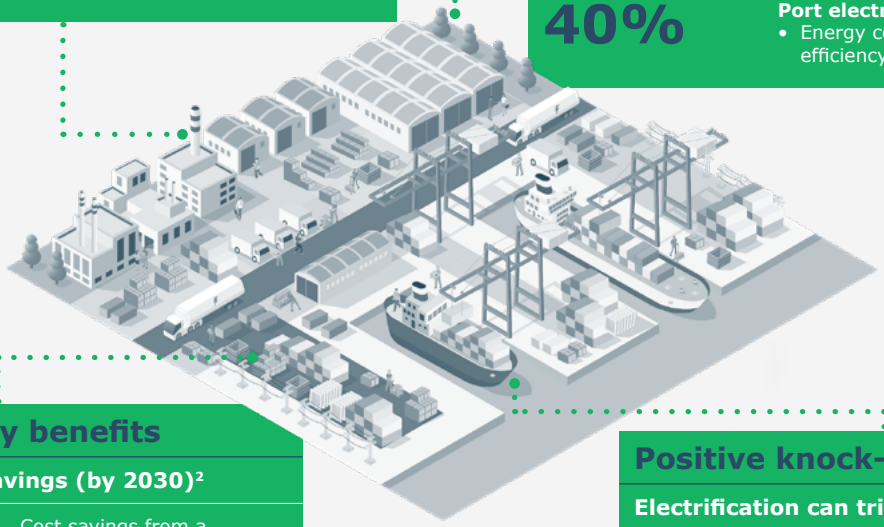
Port electrification:
- Replacement of CHE
- Deployment of new solar and back-up capacity
- Grid upgrades

Truck electrification:
- Deployment of 50 electric trucks + charging

Energy cost savings (by 2030)

40%

Port electrification:
- Energy cost savings from efficiency gains



Local community benefits

Health-related cost savings (by 2030)[2]

US$45M per year — Cost savings from a reduction in air pollution-induced premature deaths

Job improvements

Electrification leads to **labour upskilling** and **better pay**

Positive knock-on effects

Electrification can trigger:

- Increased **trade competitiveness**
- Reduction in **economic losse**s from grid outages, and
- Expanded **energy access** in underserved areas

Source: Systemiq analysis
[1] GHG – Greenhouse gases
[2] Savings assuming electrification combined with low-carbon electricity generation

By 2030, Nigeria could attract approximately ₦1.3 trillion (~US$830 million) in cumulative new investments through electrification.[36]

In ports, this includes: (i) the full replacement and modernisation of diesel CHE with e-CHE at Apapa, Tin Can Island, and Onne;[37] (ii) the deployment of 50 MW of solar generation capacity (on-site and off-site) to fully meet electricity demand; (iii) the installation of backup systems (e.g., batteries as first line of defence, followed by potentially gas turbines) across all three ports; (iv) upgrades to grid infrastructure, including substation enhancements and new transmission and distribution lines; and (v) civil works to make terminals electrification-ready.[38] Although this electrification roadmap would require ₦325 billion (~US$200 million)

more in upfront investments than sticking with diesel CHE for future replacements, the benefits of switching to e-CHE more than justify the additional investments. Electrification offers substantial long-term savings and improved resilience. Across Apapa, Tin Can Island, and Onne, fully electrifying operations with grid-supplied power could reduce energy costs by up to 40%.[39] Integrating on-site solar and BESS - with levelised costs as low as ₦100/kWh - could drive costs even lower while boosting energy security.

Beyond ports, piloting electric trucks by 2030 would call for a modest investment of around ₦16 billion (~US$10 million) to deploy 50 electric trucks and the supporting low-carbon infrastructure,[40] making it a cost-effective step to demonstrate the operational viability of electric trucks and their lower total cost of ownership. Crucially, this would break the classic "chicken-and-egg" challenge by proving that reliable, affordable, low-carbon charging can scale with vehicle deployment, and serve as a proof-point for other sectors beyond container haulage freight to electrify, spurring a domino effect in further investment and innovation across Nigeria.

Electrification can also deliver real benefits to local communities - through cleaner air, quieter environments and better jobs.

Replacing diesel with electric equipment eliminates tailpipe emissions, significantly reducing harmful pollutants like NO_x and PM2.5 and improving health in nearby urban communities. It also cuts noise pollution, enhancing quality of life for communities living near congested, diesel-heavy freight corridors.

The cost of inaction is steep: by 2030, deaths caused by air pollution would lead Nigeria to forego ₦370 billion (~US$225 million) in economic benefits. A focused initial phase consisting of electrifying port operations and deploying 50 electric trucks inland could recover ₦33 billion (~US$20 million) per year,[41] with savings rising to ₦74 billion (~US$45 million) if powered entirely by renewables.[42]

Beyond public health, electrification also transforms labour demand - shifting from diesel mechanics to higher-skilled electrical technicians, typically offering better pay, training, and long-term career prospects.

Additionally, electrification can deliver greenhouse gas reductions of 390,000 $ktCO_2e$ per annum.

Even with today's grid mix, replacing diesel CHE with e-CHE at Apapa, Tin Can Island, and Onne could reduce annual emissions by about 40,000 tonnes of CO_2 by 2030. If the grid itself is decarbonised, those savings could double.[43] Similarly, fully electrifying container haulage trade across Nigeria could cut emissions by as much as 310,000 tonnes per year. Even greater reduction would be possible if the power supply is green.[44] In the roadmap above, even a modest pilot trucking program - electrifying 50 trucks by 2030 - could cut annual emissions by around 2000 tonnes of CO_2.[45] Given that road transport contributes 60% of Nigeria's emissions[46] and over 1.5 million trucks operate on its roads,[47] scaling up from this pilot could pave the way to decarbonising 25 million tonnes of CO_2, a quarter of Nigerian current emissions.

Finally, electrifying container transport could trigger a series of positive knock-on effects.

Running at lower costs, an electrified freight system could **boost Nigeria's competitiveness** and, by extension, its position as a regional trade hub. The grid and generation upgrades needed to power electric freight could also ease Nigeria's chronic energy reliability issues, helping to **reduce the country's ₦40.1 trillion (US$25 billion) annual GDP loss from outages**.[48] This would expand energy access for both underserved areas as well as a burgeoning breeding ground for new start-/scale-ups in the transition economy.

[36] One US dollar is assumed equivalent to 1605 naira at the time of writing.

[37] Apapa, Tin Can Island and Onne are clear first movers given their larger share of national container flows, ageing nature of their existing equipment, and opportunity to align electrification with investment cycles. Lekki's recent commissioning and modern assets make it a lower priority in the short term, while Rivers and Delta ports' smaller container volumes suggest a later-stage focus.

[38] This includes infrastructure work for mobile harbour cranes or RTGs, such as enabling them to connect to the electrical grid.

[39] By 2030, energy cost savings from electrification could reach ₦12 billion (US$7.3 million) annually, based solely on operating cost reductions from electric equipment, excluding additional savings from renewable generation. These savings relate to an estimated US$120 million in electrification investments, which could be recouped within roughly 16 years through OPEX reductions alone. This payback period does not yet account for other benefits such as lower maintenance costs or insulation from diesel price volatility. The calculation assumes electric equipment is 2.6 times more energy-efficient than diesel, with grid electricity priced at ₦190/kWh - less than half the cost of diesel-generated electricity (₦350–400/kWh) and significantly cheaper than diesel fuel itself at ₦1,000/litre. The 2.6x efficiency factor is based on a diesel energy content of 10.5 kWh/litre and 25% engine efficiency, as validated by expert interviews.

[40] Low-carbon infrastructure: CCS charging infrastructure and required solar PV generation

[41] Electrifying port operations using Nigeria's current grid (at 442 gCO_2/kWh) could generate approximately US$20 million in annual fuel cost savings. With a fully decarbonised grid, the savings would be even greater.

[42] Value of Statistical Life (VSL) is used to quantify the economic benefits of reduced mortality. For this calculation, the VSL used in Yaduma et al (2012) of US$489,000 was adopted. According to the World Bank, an estimated 30,000 people die annually in Lagos due to air pollution, while 26,443,656 tonnes of CO_2e are emitted in the state. Based on these assumptions, Forgone Economic Benefits = (Port Emissions + Trucking Emissions) * (VSL * Air Pollution Mortality / Emissions). For sake of simplicity, this calculation assumes that the Forgone Economic Benefits per tonne of CO_2e (US$554.76/$tCO_2e$) is the same throughout Nigeria as they are within Lagos.

[43] Total emissions reduction potential of 80 $ktCO_2e$.

[44] Additional emissions reduction potential of 100 $ktCO_2e$.

[45] Assumes that all electricity used to power these trucks comes from fully renewable sources.

[46] Michael M. Aba et al. (2023), *Energy transition pathways for the Nigerian Road Transport: Implication for energy carrier, Powertrain technology, and CO_2 emission*, Sustainable Production and Consumption, vol. 38, p55-68

[47] Systemiq analysis, based on expert interviews. Trucking (light, medium, and heavy) in Europe accounts for approximately 40% of total road transport emissions (Source: Destatis (2024), Road Transport: EU-wide carbon dioxide emissions have increased by 21% since 1990). Applying a similar proxy to Nigeria, trucking emissions could represent around 24% of total national emissions, or approximately 25 $MtCO_2$ per year. This estimate aligns well with a back-of-the-envelope calculation based on 1.5 million trucks, each consuming an average of 25 LGE per 100 km and driving approximately 30,000 km per year—resulting in an estimated 25.6 $MtCO_2e$ annually.

[48] World Bank (2019), Technical Note: *Igniting Economic Growth by Reforming Nigeria's Power Sector*

4.
Delivering the vision: public–private actions to turn roadmap into reality

As outlined above, electrifying Nigeria's containerised freight system presents a transformational opportunity. However, realising these benefits will require addressing two critical challenges: **(i) ensuring reliable, affordable power supply and infrastructure,** and **(ii) enabling the electrification of equipment both in ports and along inland transport routes.** This **section outlines a practical set of actions** to address each challenge, **across two time horizons:** immediate actions to kick-start implementation before 2027, followed by longer-term measures to sustain the transition over the next 5-10 years.

Exhibit 4. Overview of practical actions stakeholders can take to address electrification challenges

Key stakeholders:

- **Public sector**
- **Private sector**

Nigerian Ports Authority | Federal ministries | Development finance institutions

Terminal operators | Trucking operators | Energy operators

		Short term (2025-2027)	Long term (2028 and beyond)
Ports	Secure reliable and affordable power supply and infrastructure	Connect off-grid ports to the national grid and strengthen transmission and distribution network to ensure stable and reliable electricity.	
		Invest in cost-effective new generation capacity by prioritising solar (onsite or via PPAs); complement this with battery energy storage systems (BESS) as first line of backup.	
	Support equipment electrification	Introduce electrification requirements in port tenders and concession agreements to ensure operator commitments.	Encourage steady equipment replacement with electric options at a natural replacement rate, starting at major ports (e.g., Lekki) to build a long-term zero-emission equipment base.
		Allow for longer concession timelines to reflect the upfront capital investments required for electrification.	
Trucks	Secure reliable and affordable power supply and infrastructure	Address the chicken-and-egg problem of charging facilities first vs. electric trucks first by investing in shared charging hubs at key depots and near the port, equipped with solar generation and BESS to ensure reliable and cost-effective charging.	Develop shared-use charging and clean power infrastructure to lower costs and improve utilisation, including exploring opportunities to share infrastructure between different modes of electric vehicles to maximise efficiency (e.g., trucks and buses, as per ongoing pilots).
			Support localised value chains by working with OEMs to develop domestic manufacturing, servicing, and maintenance capabilities and foster the growth of indigenous electric mobility startups.

	Support equipment electrification		Launch a container haulage electrification pilot to demonstrate on-the-ground Total Cost of Ownership competitiveness with diesel and compressed natural gas trucks.		Leverage second-hand electric truck markets as they mature globally to ease adoption among smaller operators.
			Engage Development Finance Institutions (DFIs) to help de-risk and accelerate early investments in charging infrastructure and electric trucks.		Keep pace with evolving charging technologies trends in China and Europe (such as battery-swapping stations or dual CCS charging) to ensure compatibility and future-proofing of infrastructure investments.
			Form a multi-stakeholder consortium, likely anchored by an anchor player (e.g., large domestic player or international logistics firm) to coordinate further pilots and drive market development.		
Cross-cutting	Secure reliable and affordable power supply and infrastructure				Fast-track regulatory approvals for grid upgrades and new power generation to accelerate readiness.
					Prepare the grid for increased demand and renewables integration, including transmission and distribution strengthening (e.g., independent transmission and distribution projects as in Kenya) and grid balancing/ flexibility solutions.
					Reform power market structures to enable private-sector investment via streamlining land acquisitions.
	Support equipment electrification				Embedding containerised freight electrification into national planning to align with broader energy and transport policies, especially on power.
					Scaling concessional and blended finance tools (e.g., results-based grants, viability gap funding, concessional debt) to de-risk private investments and accelerate deployment.

While obstacles persist, the electrification of Nigeria's container transport is not only within reach – it is the smarter and more sustainable path forward. The roadmap laid out in this paper shows how Nigeria can move from pilot to scale—unlocking investments, better living for Nigerians and regional leadership in low-carbon trade. A credible freight decarbonisation roadmap could further unlock concessional and blended finance for greater public-private collaboration, as development finance institutions prioritise clean energy over fossil fuel investments. The time to act is now.

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