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## National Zero-Emission Freight Corridor Strategy

*Prioritizing investments, planning, and deployment for medium- and heavy-duty vehicle fueling infrastructure to advance zero-emission freight along our nation's corridors.*

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## List of Acronyms

DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
EPA	U.S. Environmental Protection Agency
EV	electric vehicle
MHDV	medium- and heavy-duty vehicle
NHFN	National Highway Freight Network
ZEF	zero-emission freight
ZE-MHDV	zero-emission medium- and heavy-duty vehicle
ZEV	zero-emission vehicle

# Executive Summary

## A National Vision

The United States has committed to decarbonizing freight transportation by advancing the deployment of commercial zero-emission medium- and heavy-duty vehicles (ZE-MHDVs) and infrastructure. It is pursuing this goal by leveraging historic federal and private investments, policies, and partnerships. Through the U.S. National Blueprint for Transportation Decarbonization<sup>1</sup> and the Global Memorandum of Understanding for Zero-Emission Medium- and Heavy-Duty Vehicles,<sup>2</sup> the United States has committed to identifying viable pathways and implementation actions that promote at least 30% ZE-MHDV sales by 2030, with a goal of 100% by 2040. These actions, along with the investments laid out in the Bipartisan Infrastructure Law and Inflation Reduction Act, put the nation on a path to advancing transportation and infrastructure solutions that are better for freight movement, our communities, the environment, and the economy.

Providing ubiquitous and convenient access to electric vehicle (EV) charging and hydrogen refueling along our nation's freight corridors, and at truck depots within freight hubs, is key to successfully deploying ZE-MHDVs. Consistent with its charge in the Bipartisan Infrastructure Law,<sup>3</sup> the Joint Office of Energy and Transportation (Joint Office), in collaboration with the U.S. Department of Energy (DOE), Department of Transportation, and the Environmental Protection Agency, has developed the *National Zero-Emission Freight Corridor Strategy* (Strategy). The Strategy guides infrastructure deployment to meet growing market demands; catalyze public and private investment; and support utility and regulatory planning and action at local, state, and regional levels. This Strategy lays out an all-of-government approach to aligning investments and accelerating sustainable and scalable deployment of reliable ZE-MHDV infrastructure.

## Starting with First Success Regions

A core objective of the Strategy is to meet freight truck and technology markets where they are today, determine where they are likely to develop next, and set an ambitious pathway that mobilizes actions to achieve decarbonization. The Strategy identifies the greatest opportunities to support early introduction of ZE-MHDVs, promoting cost savings for commercial fleets, cleaner air for communities, and strategic investments for infrastructure companies and electric utilities. This comprehensive approach is intended to support the commercial ZE-MHDV market, both where it is growing and where it can succeed first. The Strategy includes zero-emission fuels and diverse truck applications

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<sup>1</sup> [The U.S. National Blueprint for Transportation Decarbonization: A Joint Strategy to Transform Transportation | Department of Energy](#)

<sup>2</sup> [U.S. Secretary of Energy Advances America's Commitment to Reaching Net Zero Global Emissions and Combatting Climate Change at COP27 | Department of Energy](#)

<sup>3</sup> Title VIII of division J of the Bipartisan Infrastructure Law (enacted as the Infrastructure Investment and Jobs Act) (Pub. L. 117-58) (Nov. 15, 2021)

representing Classes 4 through 6 (e.g., first- to last-mile delivery trucks, local work and service trucks, and school buses) and Classes 7 and 8 (e.g., refuse, transit, coach bus, port drayage, regional haul, and eventually long-haul transportation). As infrastructure availability increases within freight hubs and connecting corridors, the opportunity for longer-range transportation to occur between these locations is more likely, catalyzing market expansion and transformation.

## Applying Key Deployment Factors

To prioritize the buildout of ZE-MHDV infrastructure nationwide, the Strategy evaluates critical deployment factors that target favorable investment areas along the National Highway Freight Network<sup>4</sup> (NHFN) and within supporting freight ecosystems. The Strategy moves through four progressive phases to promote zero-emission truck adoption from 2024 to 2027, 2027 to 2030, 2030 to 2035, and 2035 to 2040. The analysis applied the following deployment factors to determine infrastructure phasing over time:

- 1) The highest percentage of freight volume over the NHFN.<sup>5</sup>
- 2) The highest percentage of ports by annual tonnage, all intermodal freight facilities, and key truck service facility locations.<sup>6</sup>
- 3) Projected ZE-MHDV volumes that demonstrate better total cost of ownership compared to internal combustion engine trucks (e.g., early markets with first- and last-mile delivery, local and regional haul, and moving toward long-haul transportation).<sup>7</sup>
- 4) Areas that bear disproportionate environmental and air quality burden from MHDV emissions.<sup>8</sup>
- 5) States with policies that enable zero-emission vehicle deployment.<sup>9</sup>

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<sup>4</sup> [National Highway Freight Network | Federal Highway Administration Freight Management and Operations | U.S. Department of Transportation](#)

<sup>5</sup> [Highway Performance Monitoring System 2022; Freight Analysis Framework 2050 Base Line Scenario.](#)

<sup>6</sup> [See Appendices](#) for lists of key facilities included in each phase of the Strategy, which were triaged based on the U.S. Army Corps of Engineers Ports Commodity Tonnage (2022).

<sup>7</sup> Ledna, C., Muratori, M., Yip, A., Jadun, P., Hoehne, C., and Podkaminer, K. 2024. Assessing Total Cost of Driving Competitiveness of Zero-Emission Trucks. *iScience*. <https://doi.org/10.1016/j.isci.2024.109385>.

<sup>8</sup> [Nonattainment Areas for Criteria Pollutants \(Green Book\) | U.S. Environmental Protection Agency](#)

<sup>9</sup> Specifically, states that have adopted [Advanced Clean Trucks | California Air Resources Board](#)

- 6) “On-the-ground” planning for ZE-MHDVs through Department of Energy commercial zero-emission vehicle corridor planning grants.<sup>10</sup>

## Sequencing Market-Driven Actions

The Strategy demonstrates how infrastructure can be phased in around favorable launch areas in priority regions. This considers where ZE-MHDVs are more cost-effective<sup>11</sup> and targets investments, planning, utility upgrades, and deployment resulting in the rapid adoption of zero-emission trucks and infrastructure. By phasing infrastructure deployment over time, the Strategy helps sequence market-driven actions that promote a fully integrated transportation energy system. The Strategy complements the goals set by the Global Memorandum of Understanding on ZE-MHDVs, the Environmental Protection Agency’s proposed greenhouse gas rule for heavy-duty vehicles (2027 to 2032), and the implementation of state regulation and policies related to the deployment of ZE-MHDVs (e.g., states that have adopted California’s Advanced Clean Truck rule and statutory targets for transportation decarbonization).

## Phasing In ZE-MHDV Infrastructure

The Strategy seeks to prioritize and sequence the deployment of ZE-MHDV infrastructure in and around key freight hubs and along freight corridors over four phases to accelerate adoption of ZE-MHDVs and ultimately achieve a national zero-emission freight (ZEF) network. The following maps present phasing based on the described deployment factors.

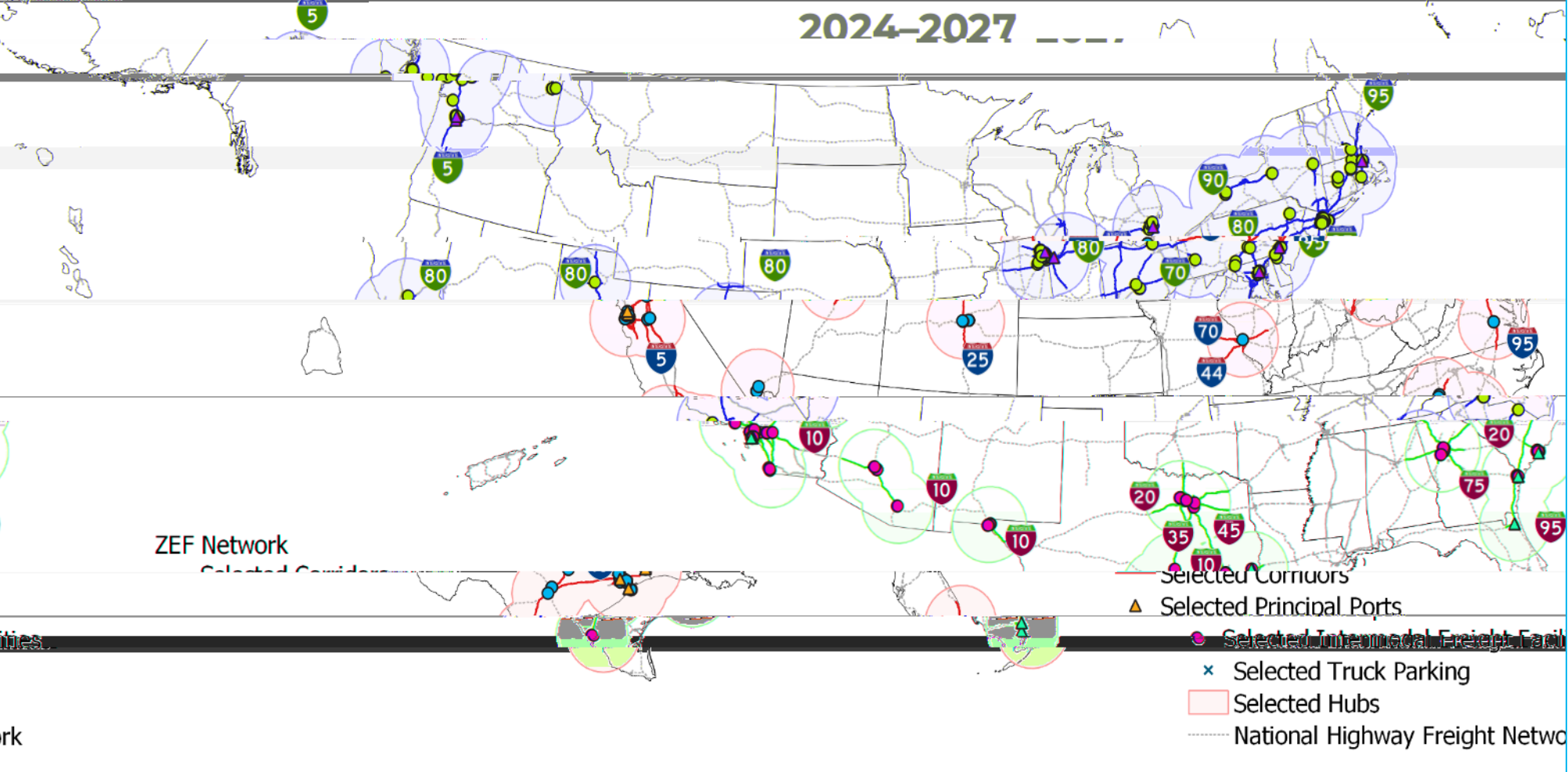
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<sup>10</sup> [Biden-Harris Administration Announces Funding for Zero-Emission Medium- and Heavy-Duty Vehicle Corridors, Expansion of EV Charging in Underserved Communities | Department of Energy](#)

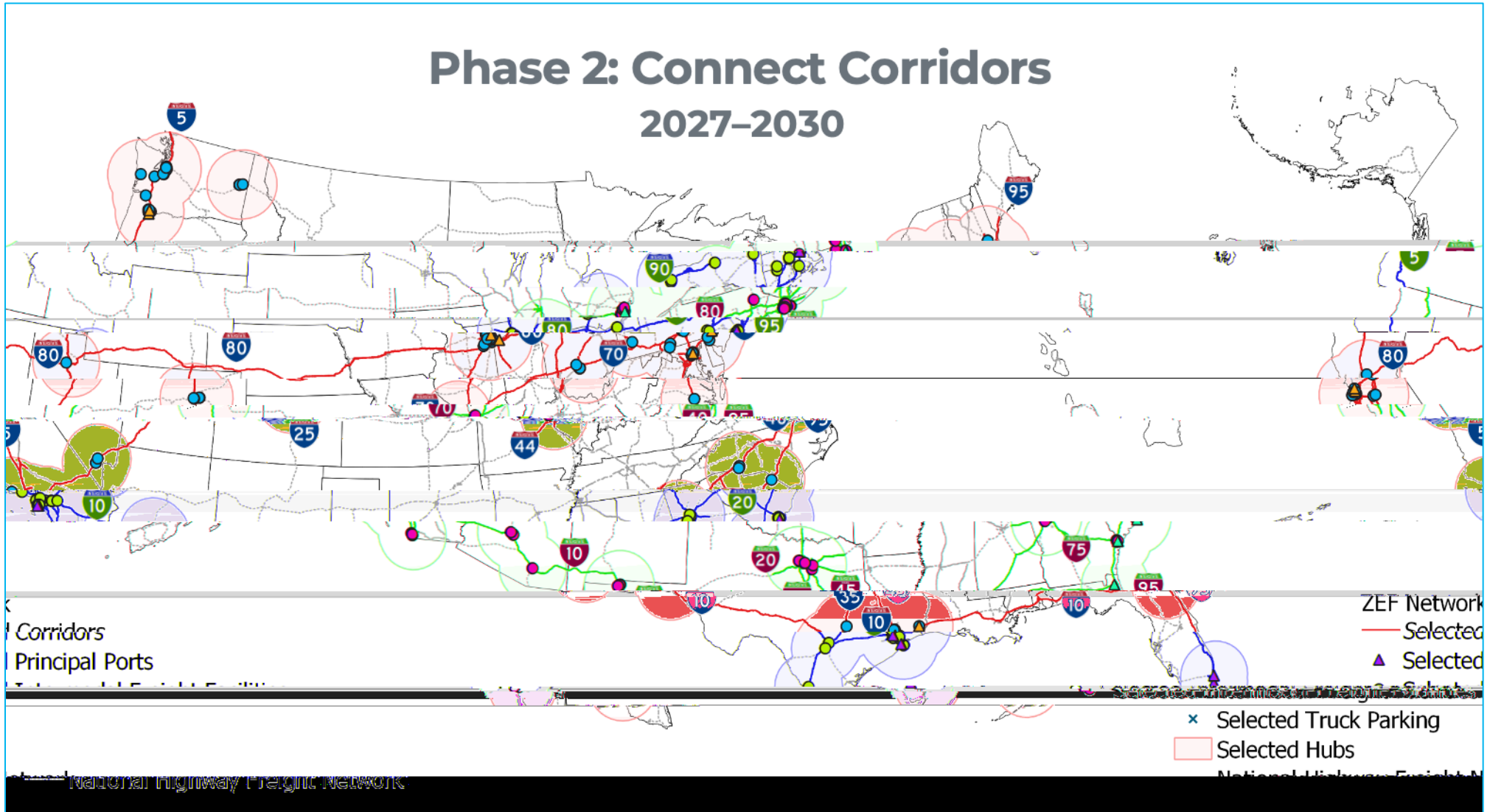
<sup>11</sup> Ledna, C., Muratori, M., Yip, A., Jadun, P., Hoehne, C., and Podkaminer, K. 2024. Assessing Total Cost of Driving Competitiveness of Zero-Emission Trucks. *iScience*. <https://doi.org/10.1016/j.isci.2024.109385>.

# Phase 1: Establish Hubs

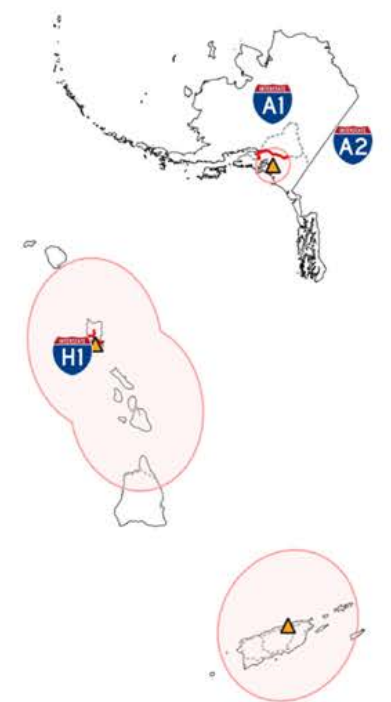
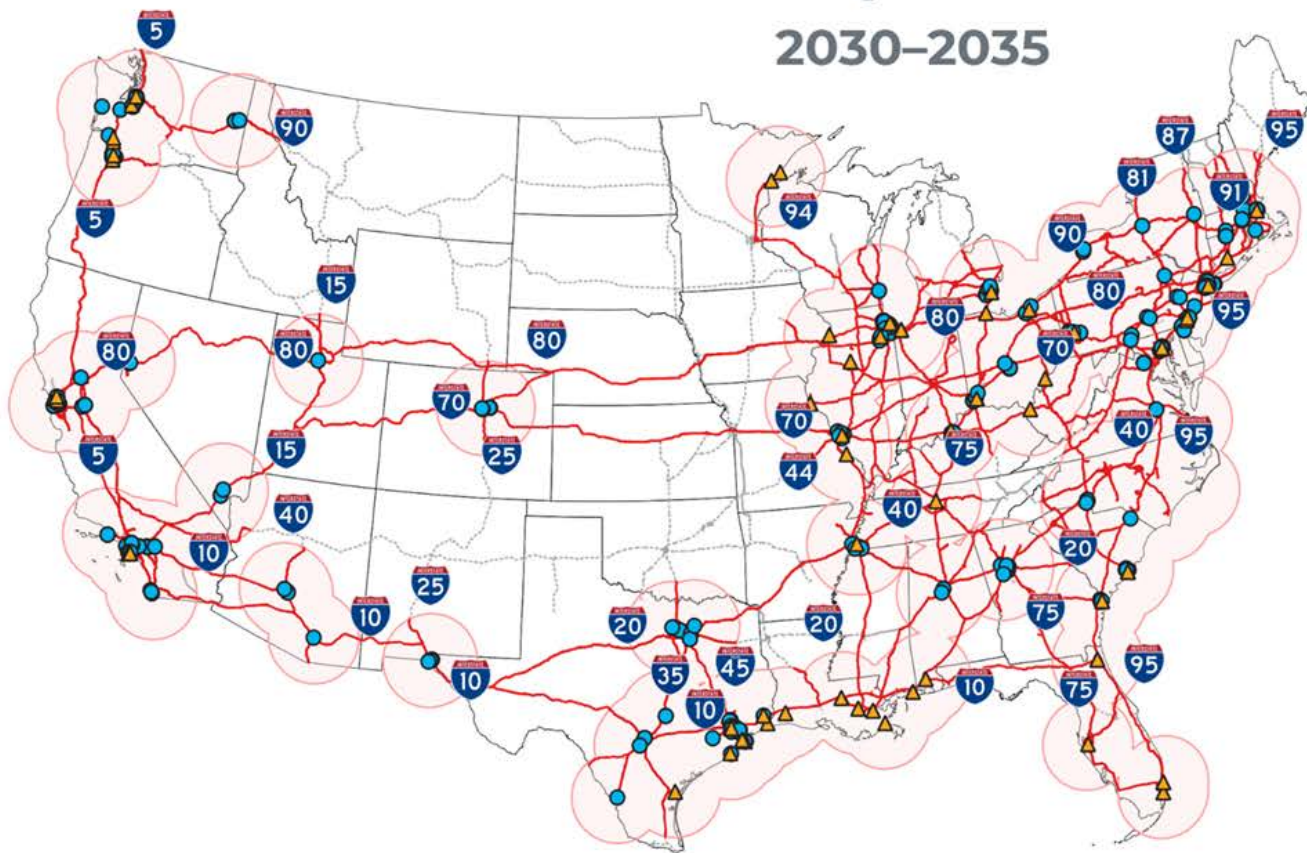
2024-2027



# Phase 2: Connect Corridors 2027-2030



# Phase 3: Expand Network 2030–2035

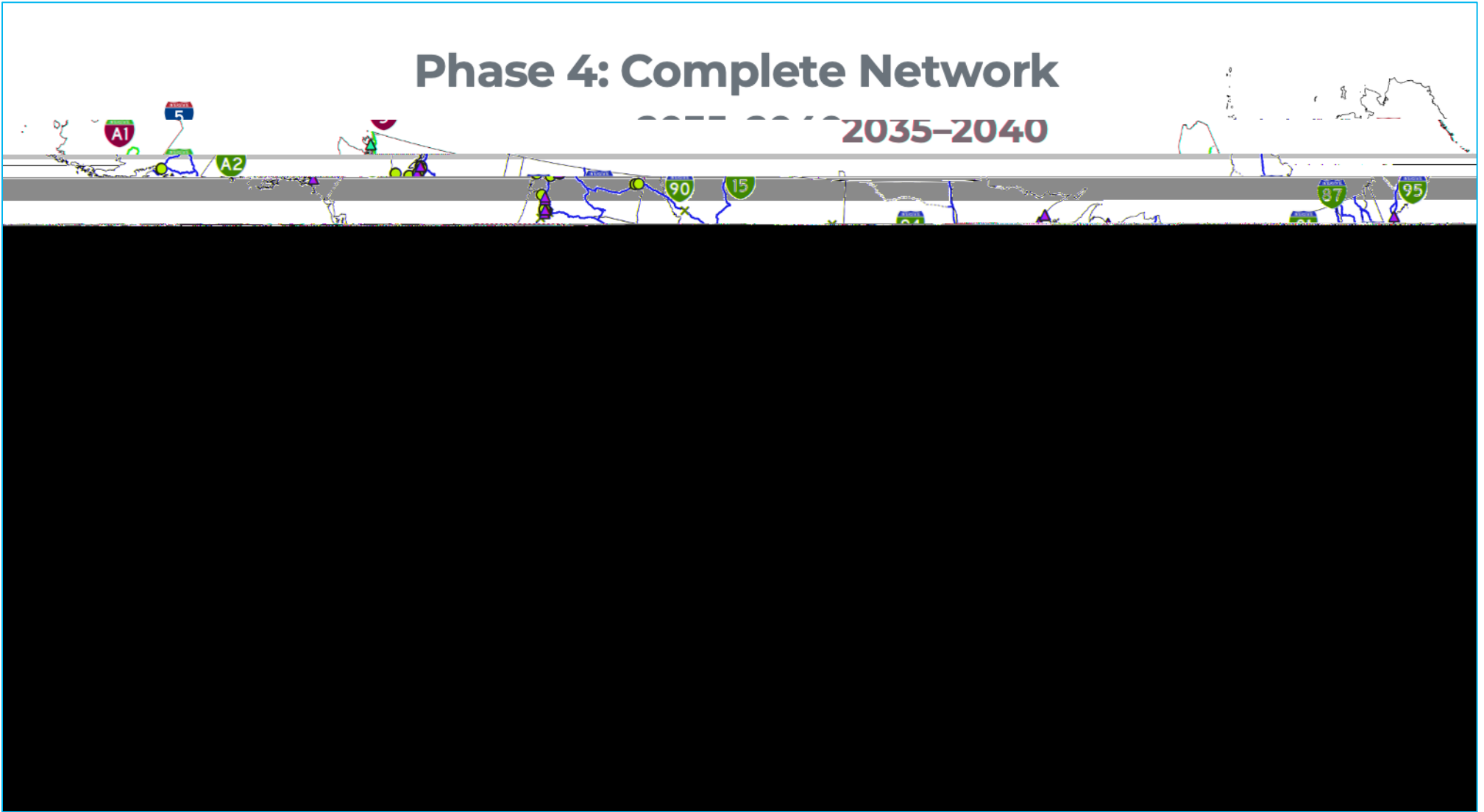


- ZEF Network
- Selected Corridors
  - ▲ Selected Principal Ports
  - Selected Intermodal Freight Facilities
  - × Selected Truck Parking
  - Selected Hubs
  - National Highway Freight Network



# Phase 4: Complete Network

2035-2040



The Strategy intends to accelerate the adoption of ZE-MHDVs by initially focusing on key freight hubs with a 100-mile radius in Phase 1, moving toward building out a complete ZEF network in Phase 4.

[Download the GIS files](#) used to create the maps for each phase. Please note the linked file is 40 MB.

## Cross-Sector Collaboration

The Strategy is designed to facilitate and expand the cross-sector collaboration needed to realize a national ZEF network. One of the outcomes of this Strategy is to help stakeholders including commercial truck fleets, industry, zero-emission fuel providers, grid and pipeline operators, energy and environmental regulators, and communities to evaluate where new electricity load and hydrogen needs are likely to develop.

For electricity, systems-level analysis on how freight volumes at commercial fueling locations will impact distribution and transmission needs can support planning and investment at the local, state, and regional levels. By evaluating existing energy capacity, potential grid constraints, and innovative strategies to scale power, the Strategy can support critical transmission planning to support prioritized corridor phasing.

For hydrogen, fuel producers and vehicle manufacturers can use the Strategy to align planning for production, fuel delivery, and market development in favorable launch areas. With DOE's \$7 billion investment in seven regional clean hydrogen hubs throughout the U.S.,<sup>12</sup> the Strategy complements the expected increased production capacity to serve key freight corridors.

Another example of cross-sector collaboration is DOE's seven commercial ZE-MHDV corridor planning grants.<sup>13</sup> These grants involve public, private, and community partners working together to evaluate energy needs; identify locations for charging and hydrogen refueling infrastructure; and develop deployment plans to catalyze public and private investments for ZEF corridors.

## Mobilizing Outcomes

The Strategy is designed to mobilize market activity around ZE-MHDVs across multiple sectors. For example, federal and state government can use the Strategy to prioritize and align public infrastructure grants, loans, and other investments. The energy sector can incorporate the Strategy into systems-level planning to align grid development and fuel production with ZE-MHDV needs. Industry can have greater transparency on infrastructure priorities to inform planning and ZE-MHDV investments in communities that

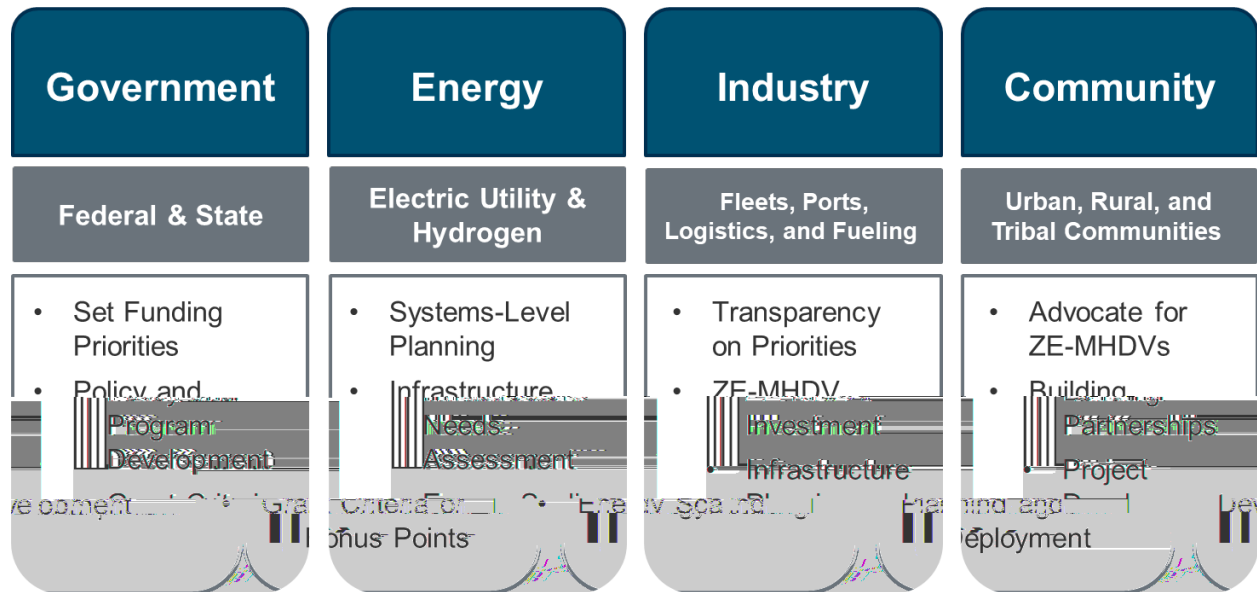
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<sup>12</sup> [Regional Clean Hydrogen Hubs | Department of Energy](#)

<sup>13</sup> [Biden-Harris Administration Announces Funding for Zero-Emission Medium- and Heavy-Duty Vehicle Corridors, Expansion of EV Charging in Underserved Communities | Department of Energy](#)

they serve around the nation. Communities can use the Strategy to inform advocacy, partnerships, and project development to promote cleaner transportation solutions.

Figure 1 highlights opportunities for Strategy implementation across key stakeholder groups.



**Figure 1. National Zero-Emission Freight Corridor Strategy stakeholder groups and implementation**

### Adapting to Market Needs

The *National Zero-Emission Freight Corridor Strategy* is intended to catalyze scalable and sustainable investment in ZE-MHDVs around the country. The Strategy will be reevaluated periodically to effectively accelerate rapid growth in the adoption of ZE-MHDVs and ensure that its goals and methodology reflect real-world economics, technological capabilities, market development, and community interests. This Strategy maintains the flexibility to adjust expected timing and to reflect the significant private investment to decarbonize freight that is already underway around the nation. The Joint Office intends to revise the Strategy at least annually through engagement with the Joint Office’s Electric Vehicle Working Group, requests for information, public-private efforts such as DOE’s 21<sup>st</sup> Century Truck Partnership, and other opportunities for public engagement.

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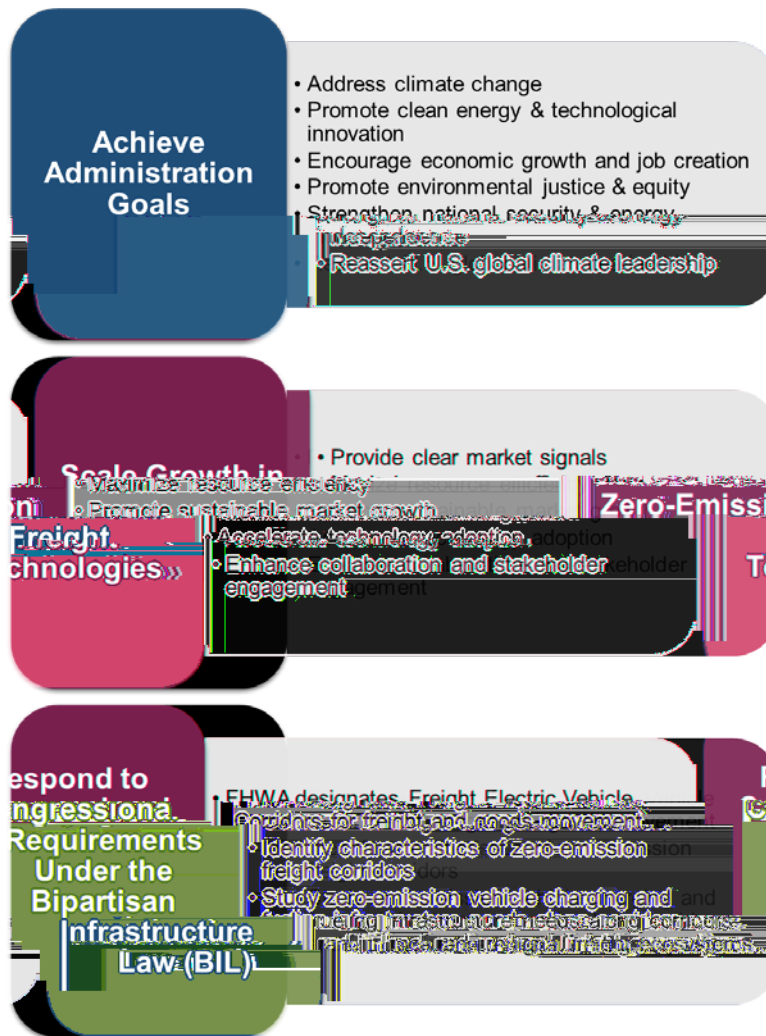
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# Introduction

The Joint Office of Energy and Transportation (Joint Office) partnered with the U.S. Department of Energy (DOE), the Department of Transportation (DOT), and the Environmental Protection Agency (EPA) to develop the *National Zero-Emission Freight Corridor Strategy* (Strategy). The Strategy is a coordinated, all-of-government approach that supports national clean energy and transportation goals and will help catalyze already increasing levels of private investment to decarbonize the movement of freight and goods around the nation.



**Figure 2. National clean energy goals**

In addition, the Strategy is a framework to prioritize federal investments in commercial zero-emission medium- and heavy-duty vehicles (ZE-MHDVs) and infrastructure to ensure the best outcomes for communities, fleet and fueling operators, and the economy. The Strategy provides agencies with a consistent tool to develop criteria or award additional consideration (e.g., priority weighting in a grant program evaluation) for projects

that align with the identified priority zero-emission freight (ZEF) hubs and corridors during each of the Strategy's four phases between 2024 and 2040.

The Strategy is intended to address key national priorities. As shown in **Figure 2**, the Strategy will support key national clean energy goals related to climate change, technical innovation in clean energy, economic growth, workforce development, environmental justice, national security, and U.S. climate leadership. The Strategy also supports scalable and sustainable private market growth in ZEF technologies by sending clear market signals; supporting grid transformation and resiliency; maximizing the efficient use of resources such as federal deployment funds; accelerating technology innovation and adoption; and enhancing stakeholder collaboration and engagement across jurisdictions.

Finally, the Strategy responds to Congressional direction. It is a combined and coordinated effort, building on Congressional authorization for Federal Highway Administration to designate freight electric vehicle (EV) corridors and for the Joint Office to develop a national study on zero-emission vehicle (ZEV) charging and refueling infrastructure needs for ZE-MHDVs.

Title VIII of division J of the Bipartisan Infrastructure Law requires the Secretary of Transportation to “designate national electric vehicle charging corridors that identify the near- and long-term need for, and the location of, electric vehicle charging infrastructure to support freight and goods movement at strategic locations along major national highways, the National Highway Freight Network established under section 167 of title 23, United States Code, and goods movement locations including ports, intermodal centers, and warehousing locations.”<sup>14</sup> The Federal Highway Administration's intent to designate freight EV corridors was first identified on May 18, 2023 through its Round 7 Request for Nominations for Alternative Fuel Corridor designations.<sup>15</sup>

The publication of the Strategy by the Joint Office is consistent with the Congressional direction under BIL to develop “a national and regionalized study of zero-emission vehicle charging and refueling infrastructure needs.”<sup>16</sup>

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<sup>14</sup> United States Code, Title 23, Section 167, “National highway freight program,” subsections (c)-(f), <https://uscode.house.gov/>

<sup>15</sup> [Request for Nominations – Alternative Fuel Corridors \(May 18, 2023\) | Department of Transportation](#)

<sup>16</sup> 135 Stat. 1425.

# National Zero-Emission Freight Corridor Strategy

## Goal and Objectives

The goal of the Strategy is to align public policy and investments by prioritizing infrastructure deployment along the National Highway Freight Network (NHFN) and complementary roadways through a progression of phases to accelerate the adoption of commercial ZE-MHDVs. This all-of-government approach intends to catalyze public and private investment, accelerate industry activity, and signal electricity and hydrogen markets to plan and deploy necessary generation, transmission, and distribution projects. These activities serve the timely and sustainable infrastructure buildout for a complete ZEF network.

## Methodology

The methodology used to inform the Strategy evaluated critical deployment factors that prioritize favorable investment areas along the NHFN (e.g., freight corridor segments), as well as key origin-destination points and surrounding freight hubs. The methodology started by identifying hubs, which the Strategy defines as a 100-mile to a 150-mile radius zone or geographic area centered around a point with a significant concentration of freight volume (e.g., ports, intermodal facilities, and truck parking), that supports a broader ecosystem of freight activity throughout that zone.

The Strategy analysis considered deployment factors including:

- 1) The most **heavily used freight corridor segments by freight volume** on the NHFN (top 25% in Phases 1–3 and top 50% in Phase 4).<sup>17</sup>
- 2) The most **heavily used ports by annual freight tonnage** (top 20% in Phases 1–2, top 40% in Phase 3, and top 60% in Phase 4), intermodal freight facilities, and key truck service facility locations.<sup>18</sup>
- 3) **Projected ZE-MHDV volumes that demonstrate optimal total cost of ownership** compared to internal combustion engine trucks (e.g., early markets with first- to last-mile delivery, local and regional haul, and moving toward long-haul transportation).<sup>19</sup>

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<sup>17</sup> [Highway Performance Monitoring System 2022](#); [Freight Analysis Framework 2050 Base Line Scenario](#).

<sup>18</sup> [See Appendices](#) for lists of key facilities included in each phase of the Strategy, which were triaged based on the U.S. Army Corps of Engineers Ports Commodity Tonnage (2022).

<sup>19</sup> Ledna, C., Muratori, M., Yip, A., Jadun, P., Hoehne, C., and Podkaminer, K. 2024. Assessing Total Cost of Driving Competitiveness of Zero-Emission Trucks. *iScience*. <https://doi.org/10.1016/j.isci.2024.109385>.



4) **Locations that bear disproportionate environmental and air quality burden** from MHDV transportation and are in nonattainment for criteria air pollutants.<sup>20</sup>

5) States with **policies that enable ZEV deployment**.<sup>21</sup>

6) “On-the-ground” planning for ZE-MHDVs through DOE’s **commercial ZEV corridor planning grants**.<sup>22</sup>

By applying these deployment factors, the Strategy presents a progression of infrastructure deployment along the NHFN over four phases. Each phase demonstrates increased growth over time and helps the nation meet critical commercial ZE-MHDV adoption rates by 2027, 2030, 2035, and 2040.

### Phased Outcomes for Infrastructure Buildout

The Strategy prioritizes, sequences, and accelerates infrastructure buildout along key freight corridors and hubs in four phases. The Strategy’s key outcomes, as referenced in Figure 3, include establishing priority hubs based on freight volumes in Phase 1, connecting hubs along critical freight corridors in Phase 2, expanding corridor connections and initiating network development in Phase 3, and achieving a national network by linking regional corridors for ubiquitous access to ZE-MHDV infrastructure in Phase 4.

It is important to note that the Strategy does not assume that investment in ZE-MHDVs will only take place within the hubs and corridors identified in each phase. The Strategy intends to catalyze and accelerate widespread private investment in ZE-MHDVs around the nation through this targeted, phased approach. Agencies should consider best practices in community engagement<sup>23</sup> and opportunities to leverage, optimize, and decarbonize existing freight, grid, and hydrogen infrastructure. Expanding the availability of ZE-MHDV infrastructure will also require a widespread effort to overlay projected freight volumes and fueling locations with systems-level analysis of electricity and hydrogen generation, transmission, and distribution capacity. This kind of systems-level analysis, which is already underway in some jurisdictions<sup>24</sup> will be essential to maintaining sustainable and scalable growth in the deployment of ZE-MHDV infrastructure.

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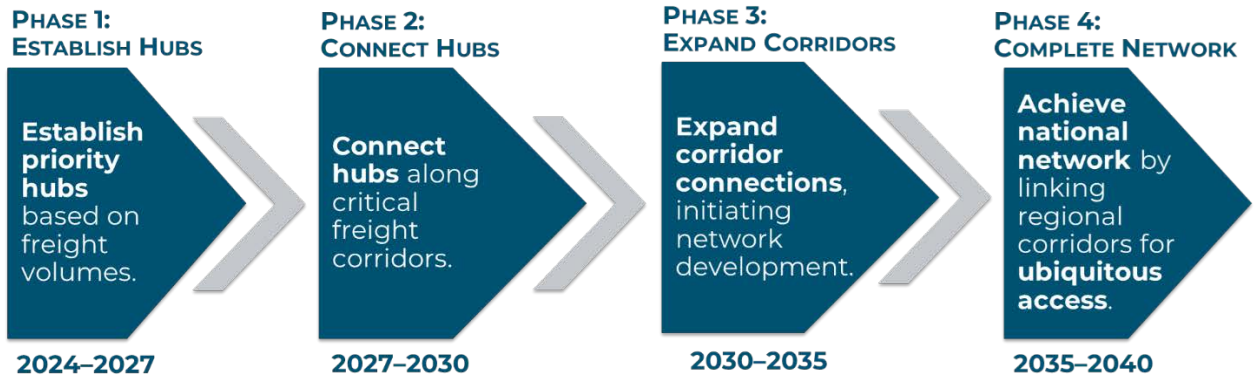
<sup>20</sup> [Nonattainment Areas for Criteria Pollutants \(Green Book\) | US EPA](#)

<sup>21</sup> Specifically, states that have adopted [Advanced Clean Trucks | California Air Resources Board](#)

<sup>22</sup> [Biden-Harris Administration Announces Funding for Zero-Emission Medium- and Heavy-Duty Vehicle Corridors, Expansion of EV Charging in Underserved Communities | Department of Energy](#)

<sup>23</sup> <https://driveelectric.gov/files/just-community-engagement.pdf>

<sup>24</sup> See, e.g., [New York PSC Case No. 23-E-0070 – Proceeding on Motion of the Commission to Address Barriers to Medium- and Heavy-Duty Electric Vehicle Charging Infrastructure](#); [California PUC Freight Infrastructure Planning](#).



**Figure 3. Phased approach for advancing zero-emission freight corridors.**

Table 1 identifies the percentage of the NHFN that would be prioritized during each phase, enabling reliable access to ZE-MHDV infrastructure (ZE-MHDV miles), the area of the ZEF hub (square miles), and the percentage of benefits from prioritizing the development of the identified ZEF ecosystems anticipated to flow to disadvantaged communities.

**Table 1. Infrastructure Phases and Timeline of Progress**

Infrastructure Phase	Phase 1	Phase 2	Phase 3	Phase 4
<b>Timeline</b>	2024–2027	2027–2030	2030–2035	2035–2040
<b>Outcome</b>	Establish Hubs	Connect Hubs	Expand Corridors	Complete Network
<b>ZE-MHDV Miles</b>	12,000 mi	19,000 mi	37,000 mi	49,000 mi
<b>NHFN % Complete</b>	23%	36%	72%	94%
<b>Area of ZEF Hubs</b>	898,000 sq mi		1.28M sq mi	3.12M sq mi
<b>% ZEF Hub Benefits to Disadvantaged Communities</b>	40%	40%	43%	47%
<b>Primary Vehicle Use Case</b>	Class 3–7 Local and regional return-to-base operations, first-/last-mile delivery, drayage	Class 3–7 Local and increased regional freight movement with long haul initiating	Class 3–8 Local, regional, and point-to-point operations with long haul enabled	Class 3–8 Local, regional, and long-haul freight movement

The following section describes the Strategy’s progression across four phases and the corresponding phase maps were developed based on deployment factors as described in the methodology.

### Phase 1: Establish Hubs [2024–2027]

Key freight hubs are identified in areas that may be most immediately suited to early deployments of first-mover battery-electric MHDV fleets with predominantly return-to-base operations. In Phase 1, a higher concentration is expected of medium-duty vehicles serving purposes such as first- and last-mile delivery trucks. Initial focus on freight ecosystems within hubs will serve as foundational elements for zero-emission regional (e.g., port drayage) and long-haul use cases longer term.

Prioritization in Phase 1 also focuses on states with regulations and market structures that encourage deployment of ZEVs, areas with EPA nonattainment status to accelerate environmental mitigation for disproportionately impacted communities, and facilities along corridors identified by the DOE Vehicle Technologies Office’s Fiscal Year 2022 MD/HD corridor planning projects.

In Phase 1, a total of 12,000 miles (23% of the NHFN) are prioritized as ZEF corridors, including I-5, I-10, I-25, I-75, I-80, I-95, and the Texas Triangle (I-10, I-45, and I-35). Additionally, ZEF hubs in Phase 1 include the 100-mile freight ecosystems centered around key ports, including but not limited to the Port Authority of New York and New Jersey, Ports of Long Beach and Los Angeles, Port of San Diego, Ports of Seattle and Tacoma, Port of Miami, Houston Port Authority, and Port of Savannah.

Forty percent of the benefits stemming from the 898,000 square miles of ZEF hubs in Phase 1, shown in Figure 4, are anticipated to flow to disadvantaged communities and represent the opportunity to decarbonize goods movement for more than 1 billion in total annual commodity tonnage.



Figure 4. Phase 1 map: Establish hubs [2024–2027]. [Download the GIS files](#) used to create the maps for each phase. Please note the linked file is 40 MB.

## **Phase 2: Connect Hubs [2027–2030]**

Phase 2 expands prioritization of ZEF corridor segments to connect key ZEF hubs from Phase 1, as shown in Figure 5. Prioritizing the connection of key ZEF hubs will support private market efforts to build out ZEF infrastructure along I-5, serving all ports along the West Coast, I-10 from California to Florida through the Southwest, major segments of I-95 on the East Coast, I-80 through the Midwest, and I-70 from Pittsburgh to St. Louis.

In Phase 2, infrastructure buildout begins to expand beyond states that have adopted California’s Advanced Clean Truck rule or have already taken proactive steps to plan for ZE-MHDV corridors. Non-tractor-trailer truck (e.g., Class 4–6 straight delivery trucks) activity likely remains battery-EV-dominant, with early introduction of hydrogen fuel cell electric truck technology for longer-distance travel. Phase 2 also begins to see the construction and ramp-up of DOE’s Regional Clean Hydrogen Hubs.<sup>25</sup> Operations expand with increased regional goods distribution (e.g., port drayage) and initial deployments of long-haul transportation.

Phase 2 prioritizes 19,000 miles (36% of the NHFN) of ZEF corridors.

**Figure 5. Phase 2 map: Connect hubs [2027–2030]. [Download the GIS files](#) used to create the maps for each phase. Please note the linked file is 40 MB.**

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<sup>25</sup> [Regional Clean Hydrogen Hubs | Department of Energy](#)

### ***Phase 3: Expand Corridors [2030–2035]***

In Phase 3, the facilities included as ZEF hubs are expanded to include a larger percentage of ports and freight facilities (by annual commodity tonnage), as shown in Figure 6. Corridor connections expand across the United States to reflect increased capacity to support point to point ZEF transportation along the entirety of I-80, I-95, I-10, and I-70, including access to charging and fueling to all coastal ports and their surrounding freight ecosystems for short-haul and regional operations. In Phase 3, both battery-electric and hydrogen fuel cell truck technology are prevalent, with increased access to hydrogen refueling along freight corridors. Phase 3 prioritizes a total of 37,000 miles (72% of the NHFN) of ZEF corridors. Forty-three percent of all benefits stemming from the 1.28 million square miles of ZEF hubs in Phase 3 are anticipated to flow to disadvantaged communities. ZEF hubs in Phase 3 represent the opportunity to decarbonize goods movement for more than 2 billion in total annual commodity tonnage.

**Figure 6. Phase 3 map: Expand corridors [2030–2035]. [Download the GIS files](#) used to create the maps for each phase. Please note the linked file is 40 MB.**

### ***Phase 4: Complete Network [2035–2040]***

In the final phase of the Strategy, as shown in Figure 7, the vast majority of the NHFN is prioritized to support expanded private investment that enables ubiquitous access to MHDV charging and hydrogen refueling along corridors east to west and north to south. Facilities reflected in ZEF hubs expand from intermodal freight and port facilities to also include truck parking facilities, which will increasingly service ZE-MHDVs across all use cases. A fully integrated transportation energy system will be essential to supporting use cases across all vehicle classes and duty cycles, allowing for local, regional, and long-haul transportation of goods and services. By 2035, DOE Regional Clean Hydrogen Hubs are in full production, serving critical regions with clean hydrogen transportation fuel.

Phase 4 prioritizes 49,000 miles (94% of the NHFN) of ZEF corridors. Forty-seven percent of all benefits stemming from the 3.12 million square miles of ZEF hubs in Phase 4 are anticipated to flow to disadvantaged communities. The ZEF hubs in Phase 4 represent the opportunity to decarbonize goods movement for more than 2.3 billion in annual commodity tonnage.

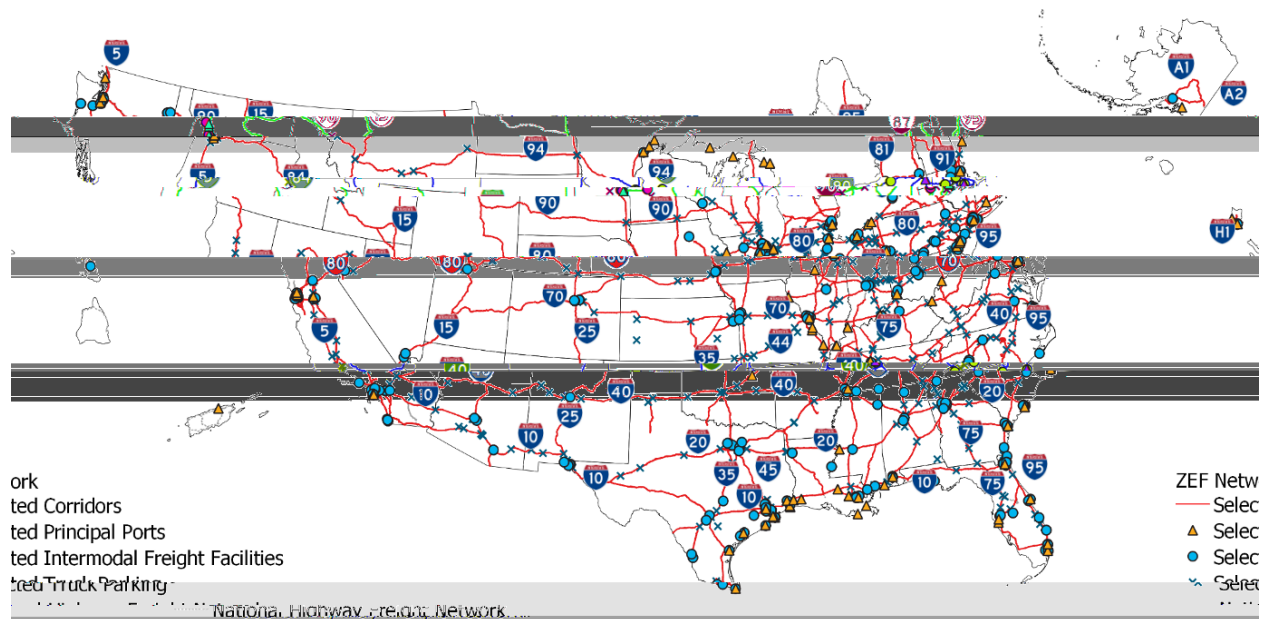


Figure 7. Phase 4 map: Complete network [2035 – 2040]. [Download the GIS files](#) used to create the maps for each phase. Please note the linked file is 40 MB.

## Strategy Implementation

The *National Zero-Emission Freight Corridor Strategy* serves as a compass for public and private stakeholders to prioritize and guide investment, planning, and deployment of ZE-MHDV electric charging and hydrogen refueling infrastructure along the NHFN and complementary roadways. Starting first in favorable launch areas and with trucks that will have lower total cost of ownership than existing internal combustion engine vehicles, the phased approach strategically deploys infrastructure, enabling emerging markets to develop, expand, and fully transform by 2040. The Strategy can be effectively implemented by federal and state governments; utility and energy providers; fleets and technology providers; ports and freight logistics companies; and communities in the ways outlined below.

### Target Public Investments

Government agencies will be able to incorporate the Strategy analysis into their own policy and program development. This “all-of-government” approach seeks to align

federal and state investments by prioritizing funding decisions on projects that fall within the deployment areas defined in the Strategy. For example, agencies preparing to issue competitive grant programs related to ZE-MHDVs and infrastructure over the 2024 through 2027 timeline can reference the Strategy's Phase 1 map to reflect the geographical representation of prioritized locations, a list of Phase 1 facilities and corridors, and distance parameters, all of which could potentially be provided as guidance to applicants within the grant solicitation.<sup>26</sup>

### ***Focus Energy Planning***

Energy markets and regulators will also be able to incorporate the Strategy into their systems-level planning and infrastructure needs assessments for the generation, transmission, and distribution of ZE-MHDV transportation fuel. By referencing the prioritized areas in each phase, utility and energy providers can include another important data point in essential energy capacity planning efforts, which are inherently specific to local, state, and regional conditions. This planning will be vitally important to serve the anticipated load on electric charging and hydrogen refueling infrastructure for commercial ZE-MHDVs.

### ***Align Industry Activity***

On-road freight stakeholders, including MHDV original equipment manufacturers; fleet and depot operators; ports; logistics and warehouse industries; retail fuel providers; and charging and refueling manufacturers will benefit from greater transparency about national freight priorities and increased certainty in near-term, medium-term, and long-term investments, planning, and deployment.

### ***Mobilize Communities for Clean Transportation***

Communities seeking opportunities to promote ZEF transportation within their regions can use the Strategy to help advocate for the deployment of commercial ZE-MHDVs and infrastructure. For example, communities can engage with local governments, utilities, and private stakeholders to leverage available public investments that reference the Strategy within the respective grant program. Communities that appear in later phases can leverage the Strategy in local and regional efforts to highlight the urgent need to begin immediate long-term planning. Adequate planning will ensure the supply of zero-emission fuel needed to support ZE-MHDV adoption, as well as charging and fueling infrastructure deployment, as markets mature.

To request technical assistance on how to incorporate the Strategy maps into your program or planning efforts, please [contact the Joint Office](#).

### ***Opportunities for Federal Agencies***

Federal agencies can implement the Strategy in a variety of ways. For example, an agency issuing grants to award funding for commercial ZE-MHDVs, or related

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<sup>26</sup> For a list of ZEF hubs and corridors included in each phase, [see appendices](#).

infrastructure, could include the Strategy's phased maps, lists of identified ZEF hubs, and location distance parameter information for the responding freight hub or corridor segment within the guidance of the grant or loan program solicitation.

The Joint Office is committed to providing technical support to public agencies that plan to implement the Strategy maps into policy, program, and regulatory development. To request technical assistance on how to incorporate the Strategy maps into your program, please [contact the Joint Office](#).

## **Alignment With Existing Policy and Areas of Future Interest**

This Strategy is part of an overall effort by the federal government to support industry, states, and communities as they transition to ZE-MHDVs nationwide. The Strategy complements existing work at DOE, DOT, EPA, and other federal agencies to support ZEV adoption, and it acknowledges the complexity and rapidly shifting nature of future zero-emission activities. In this way, the Strategy will evolve and remain relevant as an effective reference and resource for facilitating discussions around ZEF transportation.

### ***Alignment with Existing Truck Initiatives***

Concurrent research taking place across DOE and the national laboratories is developing new zero-emission truck technology for MHDV applications through the SuperTruck 3 initiative. Researchers are also exploring the potential for high-power fast charging and rapid hydrogen refueling for ZE-MHDVs. Close examination is also being given to vehicle-grid integration, which could help provide charging and hydrogen fueling to meet ZE-MHDV fleet needs in a manner that supports grid operations and resiliency, through efforts such as new county-level electric grid load forecasting tools for ZE-MHDVs. Additionally, DOE and its local partners, such as the network of Clean Cities and Communities coalitions, are providing technical assistance, education, and outreach support on zero-emission technologies to MHDV fleets and using tools through the Alternative Fuels Data Center.

### ***Areas of Future Interest***

Considerable thought and stakeholder engagement has gone into the development of the Strategy and serves as the beginning of ongoing discussions and updates to acknowledge the rapidly changing ZEF landscape. This allows the Joint Office and interagency partners the flexibility to proactively reflect changing needs, as well as track progress against each phase for industry, environment, and community benefits.

The Inflation Reduction Act has spurred changes to automotive, battery, charging, fuel cells, hydrogen infrastructure, and minerals manufacturing capabilities that will require continued proactive transportation and energy planning. Transportation and energy forecasts have not yet accounted for shifts in domestic markets.

The current surface transportation authorization is the Bipartisan Infrastructure Law, which provides \$1.2 trillion over fiscal years 2022 through 2026 in federal investment in infrastructure, including in roads, bridges, transit, rail, ports, airports, water infrastructure, resilience, and broadband. Future revisions to Strategy should inform discussions related



to how long-term infrastructure funding can complement private sector buildout of a national ZEF network.

The Joint Office intends to issue a request for information related to ZE-MHDV technology, supply chains, infrastructure, and connector standards.

## Revisions to the Zero-Emission Freight Corridor Strategy

The Strategy is intended to be a living document that evolves periodically to align goals, methodology to reflect real-world economics, technological capabilities, market development, and community needs. The Joint Office intends to revise Strategy periodically, with input from the Joint Office's Electric Vehicle Working Group and requests for information. Furthermore, the Joint Office anticipates providing other informal opportunities for feedback from interested parties on an *ad hoc* basis.

## Definitions and Assumptions

### Definitions

#### 1) Zero-Emission Freight

The fuels included in the definition of “zero-emission freight” are electricity and hydrogen.

#### 2) Zero-Emission Freight Corridor

A zero-emission freight (ZEF) corridor is a subsystem of highways that facilitates movement of battery electric and hydrogen fuel cell electric MHDVs by providing adequate, convenient, and reliable access to electric charging and hydrogen refueling infrastructure at strategic locations along the NHFN.

#### 3) Zero-Emission Freight Hub

A zero-emission freight (ZEF) hub is a zone or geographic area centered on a location with a significant concentration of freight volume (e.g., port, intermodal freight facility) that supports a broader ecosystem of freight activity and is well suited to supporting short-haul and regional freight operations in transitioning to electric and hydrogen vehicles.

#### 4) Deployment factors

Deployment factors are characteristics describing locations that, when prioritized for ZEF investments, will be key to growing and catalyzing private investment in ZEF.

### Assumptions

The pace and scale of commercial ZE-MHDV and infrastructure deployment will be informed by industry need, community benefits, economics, infrastructure requirements, commercial readiness, and signals from policymakers and regulators in these areas:

#### 1) Electric vehicle charging

- Fleets of all sizes and vehicle classes have already begun to incorporate EVs into operations, and they will continue to do so at an increasing pace.
- EV fleet duty cycles will initially focus on return-to-base and regional haul operations and expand into long-haul applications, which is aligned with earlier total cost of ownership studies by DOE national laboratories.
- Industry adoption of electric drivetrains will grow as vehicle costs reduce, repair/maintenance cost savings rise, customer experiences expand, and MHDV charging infrastructure is increasingly deployed, particularly along high-volume freight segments.
- Initial investments in public-access electric freight charging infrastructure can support opportunity charging for local delivery and return-to-base use cases, as well as some vocational uses, such as school busing and waste collection. In later phases, these investments can establish the foundation for long-haul corridors.

## **2) Hydrogen refueling**

- Hydrogen fueling infrastructure will initially be located near hydrogen production facilities, the expansion of which is being pursued by private developers and is also supported by programs like DOE's Regional Clean Hydrogen Hubs program.
- Hydrogen currently supports transit bus return-to-base operations and will likely lead to increased use in point-to-point operations and longer distance routes.
- The adoption of hydrogen fuel cell EVs by freight operators may be on a different timeline than EVs but can be similarly assumed to grow as conditions improve and as hydrogen refueling infrastructure is increasingly deployed along high-volume freight corridor segments.

For a full list of ZEF hubs, corridors, and key facilities in each phase, [please see the Appendices Document](#).