



Appendix: Chapter 6- Freight Assessment

Goods Movement and the wider 2050 LRMTTP

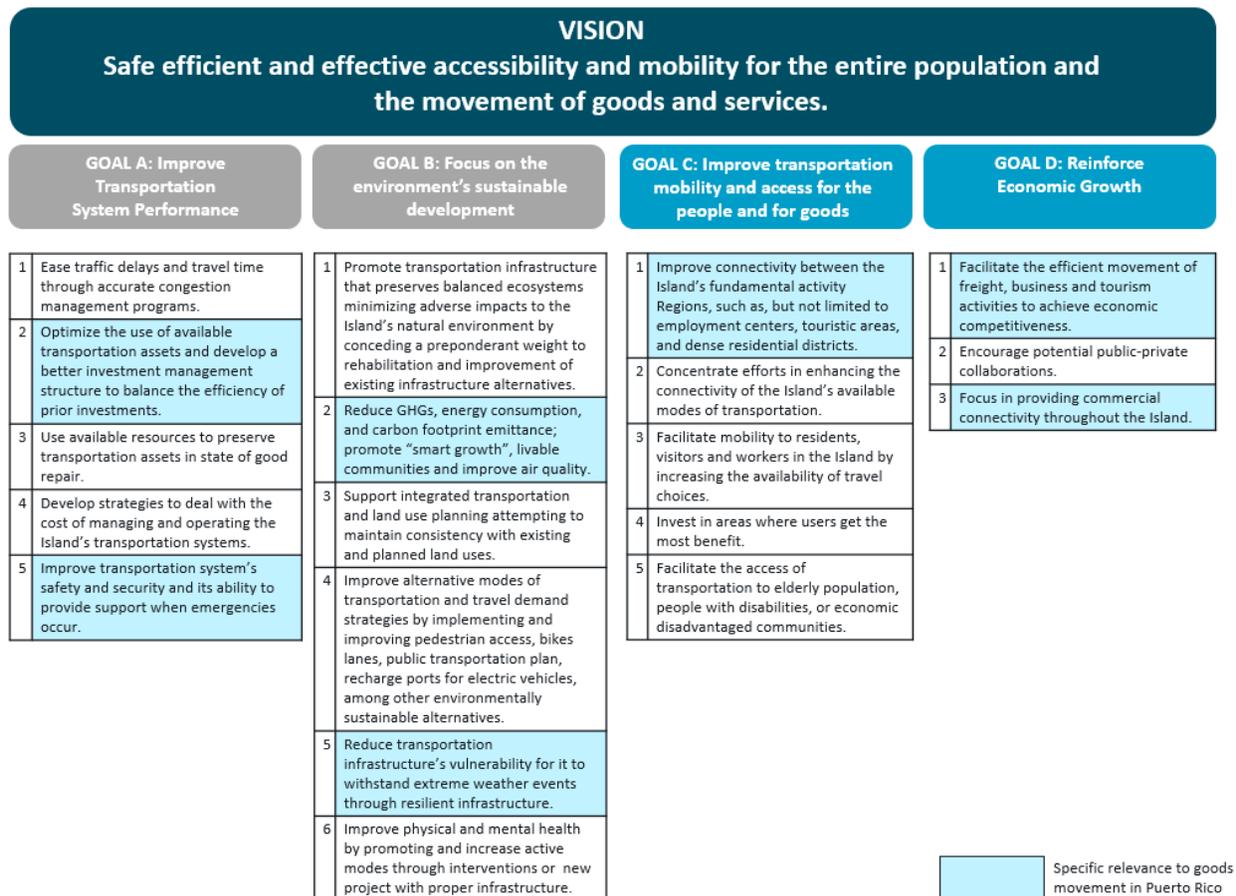
The LRMTTP vision focuses on disaster resilient infrastructure, fostering energy efficient and liveable communities, and sustainable economic development:

The Island's transportation system will be a safe, efficient and effective system that enhances the accessibility and movement of people, goods, and services.

This vision is supported by four interlinking goals. Though goods movement can be linked to each of the goals set out within the 2050 LRMTTP (see highlighted in Figure 2), freight is specifically considered within:

- Goal C: improve transportation mobility and access for the people and for goods; and
- Goal D: Reinforce Economic Growth

Figure 2: 2050 LRMTTP Vision, Goals, Objectives and linkages to goods movement



Source: Steer

Background

Freight Context

Across the region, Puerto Rico’s goods enter and exit the island through seaports and airports, with 10 available principal airports²² and 11 seaports (see Figure 3). Important to note, however, is that some airports and seaports only service people, and not goods (discussed in greater detail below). The largest (and busiest) airport and seaport are both located in San Juan: the Luis Muñoz Marín International Airport (SJU) and the Port of San Juan.

Figure 3: Puerto Rico Principal Airports and Seaports



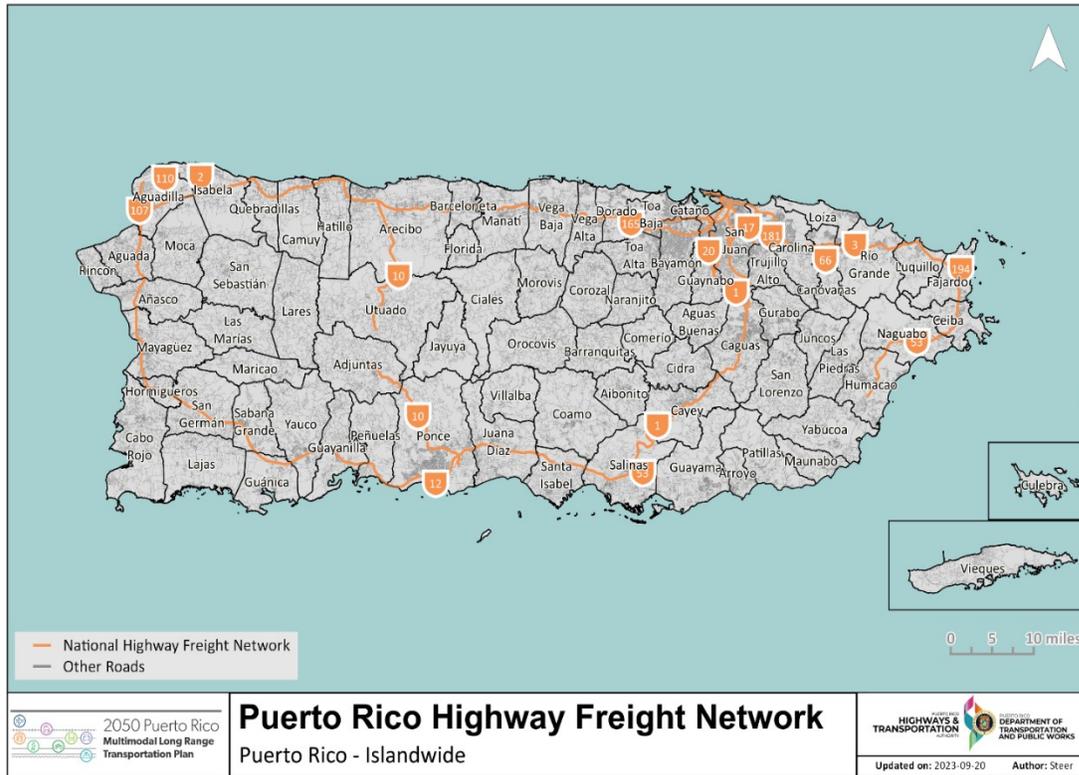
Source: U.S. Department of Transportation, Federal Aviation Administration-Aeronautical Information Services, 2023. Puerto Rico Planning Board, 2017

With no freight rail on the Island, the road network is the primary facilitator for the movement of goods across the region. In terms of freight vehicles, goods are moved using a mix of diesel-fuelled ‘medium trucks’ and ‘heavy trucks’²³. It is assumed that these same trucks are used within smaller urban and local areas, as no ‘light trucks’ or cars as part of last-mile distribution / pick-up service alternatives (e.g. cargo bikes) have been confirmed. Reflecting 2022 data in the 2050 plan, the existing road freight network is presented in Figure 4, and freight network hotspots in Figure 5.

²² Airports identified are those included in the National Plan of Integrated Airport Systems (NPIAS) for the period of 2023-2027. This National Plan identifies existing and proposed airports that are significant to national air transportation and are, in consequence, eligible to receive Federal grants under the Airport Improvement Program (AIP)³⁵.

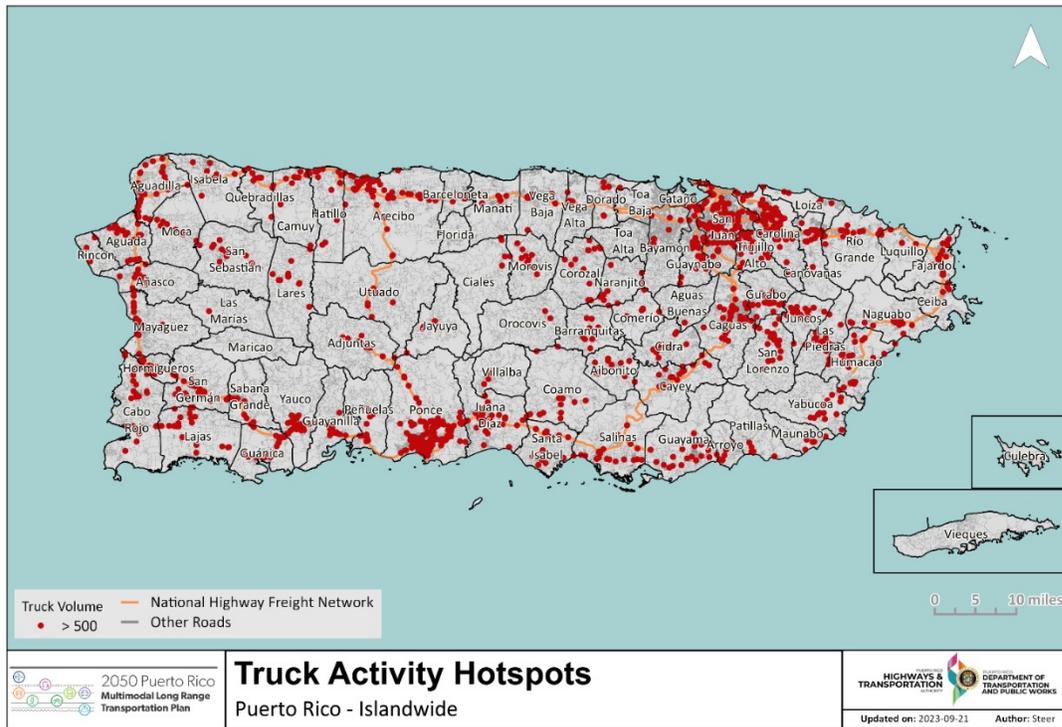
²³ Medium trucks are single-unit trucks with two or three axles in FHWA vehicle classifications 5-7. Heavy trucks include all single-trailer and multi-trailer combinations defined in FHWA vehicle classifications 8-13.

Figure 4: Existing Road Freight Network (Regional)



Source: Federal Highway Administration, Office of Freight Management and Operation, National Highway Freight Network, 2022 and U.S. Geological Survey, National Geospatial Technical

Figure 5: Existing Freight Network Hotspots (Regional)



Source: Puerto Rico Highway and Transportation Authority, 2022, Segmentos Conteos 48H Feature Server, Federal Highway Administration, Office of Freight Management and Operation, National Highway Freight Network, 2022 and U.S. Geological Survey, National Geospatial Technical Operations Center, 20230815, USGS National Transportation Dataset (NTD) for Puerto Rico (published 20230815) Shapefile: U.S. Geological Survey.

At a high level, these maps show that large volumes of goods are being transported to / from the airports and seaports (mainly in San Juan) via several key routes that connect cities and places to the west, east, and southern coast of the island. Across much of this network, freight network hotspots with a poor Level of Service are identified²⁴. These roads mainly include the interstate roads, in addition to Principal Arterials and other minor arterials throughout the region, particularly within San Juan.

More detail regarding major airports, seaports, as well as the regional and urban freight networks are discussed below. Where relevant, locally contextual considerations related specifically to the Island's two Transportation Management Areas (TMA) (San Juan and Aguadilla) are discussed.

Airports

Locations of principal airports on the island are presented in Figure 3. The Luis Muñoz Marín International Airport (SJU) in Carolina (just east of San Juan), and the Rafael Hernández Airport (BQN) in Aguadilla are the highest-ranking airports regarding cargo on the island²⁵. Both were ranked nationally in the US 34th and 78th respectively in 2021²⁶. This relatively high ranking is an indicator of the key role both airports play as cargo terminals for the Island. SJU had just over 1.4 billion pounds of landed weight for 2020 and over 1.6 billion pounds for 2021 with a percent of change of 12.7%. Meanwhile BQN had just over 359 million pounds of landed weight for 2021 and over 427 million for 2021 with a percent of change of 18.9%²⁷. In addition, the Fernando Luis Ribas Dominicci Airport (SIG) located in Isla Grande, a sub-district of Santurce, in San Juan, is classified as a commercial (small/non-hub facility) by the Federal Aviation Administration's National Plan of Integrated Airport Systems (NPIAS). According to operational reports between the 2016 and 2021 fiscal years, this airport saw a decrease of 21% in cargo volumes²⁸.

In terms of damage from recent natural hazard events, in 2021, local reports stated that the rains from Hurricane Fiona caused flooding to at least two airports on the Island, including Mercedita International Airport (PSE)²⁹. In 2017, damage from Hurricane Maria caused significant damage to Luis Muñoz Marín International Airport (SJU), including flooding, debris, power outages, damage to air traffic control systems, and associated aviation infrastructure. Following the 2020 series of earthquakes, local reports described that there was some damage to airports, including 'minor damage' to PSE, and power-outages across airports associated with earthquake damage, including SJU, subsequently impacting operations. In addition, a local report also suggests that minor damage to PSE's runway has been caused by the cumulative effects of seismic activity³⁰.

The other airports on the island only service people, not goods, and have, therefore, not been included in this discussion.

²⁴ The Highway Capacity Manual (HCM) 2010 defined Level of Service (LOS) as a quantitative stratification of a performance measure or measures that represent quality of service. There are six levels of service, ranging from A to F: from the traveler's perspective, LOS A denotes the best operating conditions and LOS F the worst. A poor level of service are networks rated as level E or F and truck volumes > 500, indicating there are sections of the road where traffic is operating at or over the capacity of the road and at the same time being highly used by trucks.

²⁵ Aeroweb. Forecast International's Aerospace Portal. Top 100 U.S. Airports in 2021.

²⁶ Aeroweb Forecast International's Aerospace Portal.

²⁷ Definition from Federal Aviation Administration: "Landed weight means the weight of aircraft transporting only cargo in intrastate, interstate, and foreign air transportation. An airport may be both a commercial service and a cargo service airport".

²⁸ Data obtained from Monthly Operational Reports from the Ports Authority FY2018-2019 to FY2022-2023.

²⁹ [Fiona dumps more rain on Puerto Rico; troops rescue hundreds | AP News](#)

³⁰ [Earthquakes rock Puerto Rico – TSA shows support | Transportation Security Administration](#)

Seaports

Locations of seaports on the island are presented in Figure 3.

The Port of San Juan is the Island's biggest seaport. It comprises various facilities around the San Juan Bay, which include passenger and cargo facilities. San Juan, Cataño and Guaynabo are the municipalities surrounding this facility, which is property of the Puerto Rico Ports Authority. Major commodities handled at the Port include manufactured products, distillate fuel oil, gasoline, foodstuffs, and kerosene³¹.

The US Department of Transportation's 2023 Report on Port Performance revealed that the Port of San Juan ranked 11th in the list of top 25 container ports in the United States by TEU (twenty-foot equivalent unit – an inexact unit of cargo capacity). Recent statistics included in the 2050 LRMTF noted that the Port of San Juan's ranked 24th in exports, 12th in imports and 18th in total trade within U.S. by *volume* of cargo, and ranked 17th in exports, 19th in imports and 17th in total trade within U.S. by *value* of cargo. From 2016 to 2021, there has been a 12.9% *increase* in total trade³². Between 2010 to 2016 imports *decreased* by 12.5% and exports *decreased* by 20.6%, according to Ports Authority data³³.

Significant activity is also associated with the Teófilo Morales Rodríguez Port in Yabucoa (southeast of the island). This port receives 33% of the crude and refined oil products that enter the island and has an approximate capacity of 4.6 million barrels of storage for refined products like fuel oil and crude oil.

The Mayagüez Port (located west of the island) is the third ranked facility on the island in terms of activity. Located along highways PR-64, PR-341 and PR-3341, it is a multipurpose seaport that handles various types of cargo and receives weekly visits by ships serving the Dominican Republic.

The Rafael Cordero Santiago Port of the Americas, in the municipality of Ponce, is a new megaport under construction. The project aims to convert the current Port of Ponce into a value-added, tax-free, customs-free, international shipping hub. Other ports of note include El Puerto de la Playa de Guayanilla (located in the south of the island), El Puerto del Malecón de Guánica (located in the southwest of the island), and the Fajardo Port (located in the east of the island). The island interior is therefore connected by a ring of ports around its periphery.

In terms of damage from recent natural hazard events, in 2017, Hurricane Maria caused substantial damage to ports across the Island. The Port of San Juan closed for four days and suffered structural damage and power-outages³⁴. In addition, damage caused to the under-construction Rafael Cordero Santiago Port of the Americas, in Ponce, caused significant delays and postponement of expansion plans. In addition, the 2020 earthquake series may have exacerbated damage caused by Hurricane Maria. A study that assessed underlying infrastructure evidenced that earthquake damage at ports had been exacerbated by underlying corrosion of the structure accelerated by increased exposure to sea water during the hurricane³⁵.

The Covid-19 pandemic evidenced and amplified the territory's economic and social crisis above mentioned. The immediate response for the Authorities at the Island resulted in quarantine, curfews,

³¹ Port of San Juan Port Performance Freight Statistics Program: Annual Report to Congress 2018.

³² Monthly Operational Reports from Ports Authority [Carga y pasajeros aéreos y marítimos | Estadísticas.PR \(estadisticas.pr\)](#)

³³ Monthly Operational Reports from Ports Authority [Carga y pasajeros aéreos y marítimos | Estadísticas.PR \(estadisticas.pr\)](#)

³⁴ [San Juan back to 84% capacity following Hurricane Maria | Container Management \(container-mag.com\)](#)

³⁵ [Frontiers | Case studies of multi-hazard damage: Investigation of the interaction of Hurricane Maria and the January 2020 earthquake sequence in Puerto Rico \(frontiersin.org\)](#)

and lockdowns per executive orders, including the shutdown of airports funneling through Luis Muñoz Marín International Airport. Below is the data showing the tendency of flow related to passengers and cargo before and after this shutdown.

Both, passenger and cargo data, reflects a dropdown from 2016 to 2017 and then comes with a slight increase, but when reaches the pandemic year it reflects a dramatic decrease where the next year starts to recover slightly year by year.

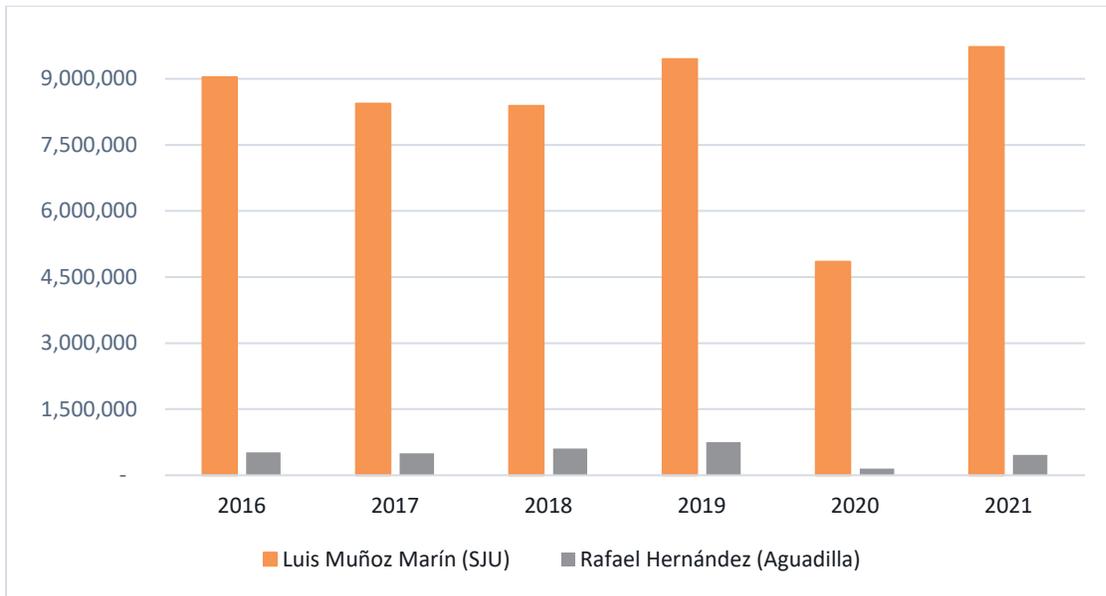
The major decrease in passenger at the airports is reflected in the two principal airports SJU and BQN where reflected a dropdown of -80%, the other airports reflected a dropdown of less than -50%, except for Humacao that reflected an increase of almost 47%.

Table 6: Airport Passengers

Airport	2016	2017	2018	2019	2020	2021	2019-2020 % Change
Mercedita (Ponce)	231,798	189,143	201,260	218,753	42,528	64,198	-80.6%
Eugenio María de Hostos (Mayagüez)	12,135	15,281	16,123	16,670	10,015	12,744	-39.9%
Benjamín Rivera Noriega (Culebra)	81,614	64,303	41,561	57,748	32,971	70,451	-42.9%
José Aponte de la Torre (Ceiba)	97,037	84,422	57,202	63,252	42,226	75,768	-33.2%
Humacao	1,154	1,000	772	490	720	3,624	46.9%
Antonio Nery Juarbe (Arecibo)	10,139	14,026	11,619	18,248	11,941	21,119	-34.6%
Antonio Rivera Rodríguez (Vieques)	131,980	1804,414	70,374	83,285	48,251	84,929	-42.1%
Fernando Ribas Dominicci (Isla Grande)	50,231	42,896	29,927	36,973	21,995	37,754	-40.5%
Luis Muñoz Marín (San Juan)	9,037,134	8,437,604	8,384,290	9,447,862	4,843,935	9,720,209	-48.7%
Rafael Hernández (Aguadilla)	519,603	498,424	608,352	753,996	149,162	461,227	-80.2%

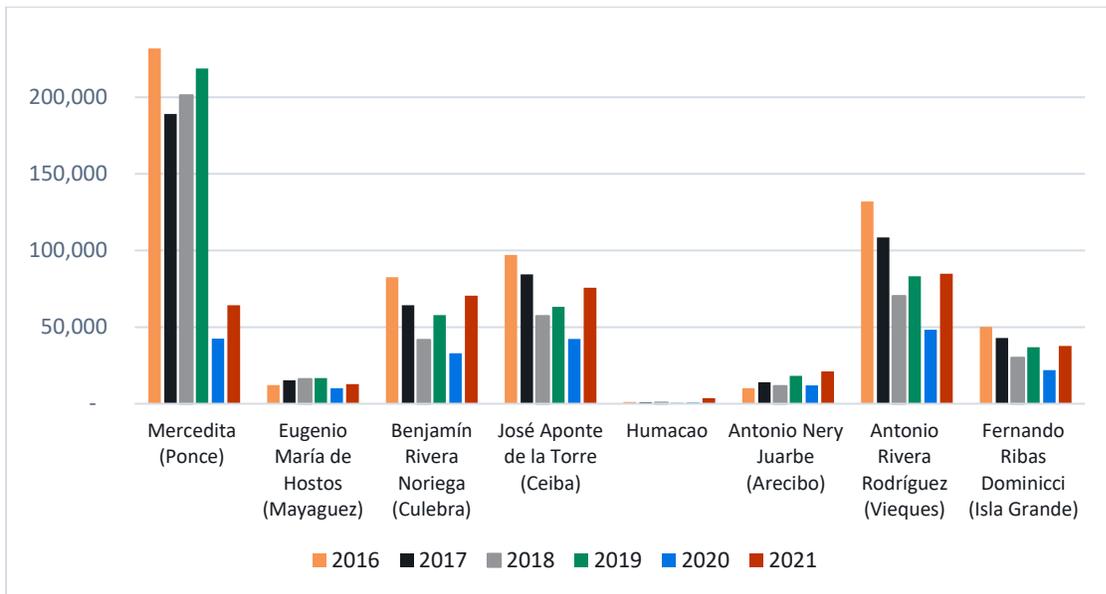
Source: Ports Authority, Monthly Operational Report FY2018-2019 to FY2022-2023

Figure 6: Puerto Rico Major Passenger Airports



Source: Ports Authority, Monthly Operational Report FY2018-2019 to FY2022-2023

Figure 7: Puerto Rico Other Passenger Airports



Source: Ports Authority, Monthly Operational Report FY2018-2019 to FY2022-2023

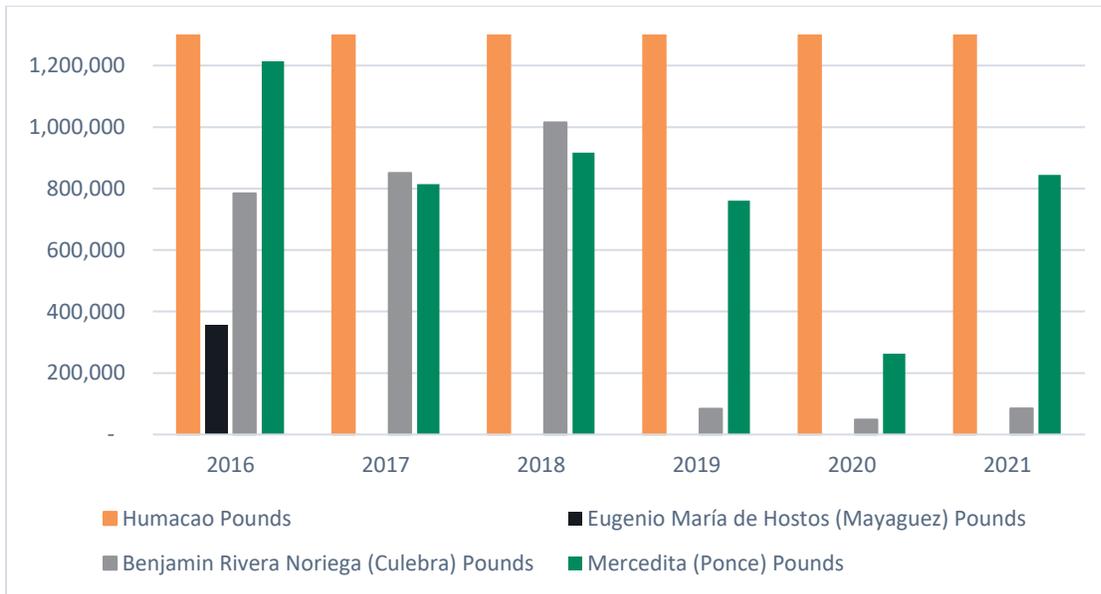
Related to cargo at the airports, the major decrease was reflected at SIG and Mercedita with -80.5% and -65.5% respectively, and the others didn't reach the -50%, with exception of Ceiba and Aguadilla airports that reflected an increase of 2% and 15.7% respectively.

Table 7: Cargo at Airports

Airport	2016	2017	2018	2019	2020	2021	2019-2020 % Change
José Aponte de la Torre (Ceiba) (Pounds)	6,801,739	7,139,118	7,421,410	7,056,861	7,198,702	7,937,839	2.0%
Humacao (Pounds)	155,582,025	142,617,792	163,735,187	166,668,413	87,658,002	116,749,462	-47.4%
Fernando Ribas Dominicci (Isla Grande) (Pounds)	15,696,798	12,309,614	13,802,424	14,343,261	2,798,120	4,566,414	-80.5%
Luis Muñoz Marín (San Juan) (Tons)	642,431	567,287	679,547	733,455	466,737	566,432	-36.4%
Rafael Hernández (Aguadilla) (Pounds)	199,780	180,947	207,474	189,635	219,330	241,865	15.7%
Eugenio María de Hostos (Mayagüez) (Pounds)	357,145	-	-	-	-	-	-
Benjamín Rivera Noriega (Culebra) (Pounds)	784,060	850,985	1,014,662	83,285	48,251	84,929	-42.1%
Mercedita (Ponce) (Pounds)	1,214,118	814,367	917,030	760,265	262,299	844,062	-65.5%

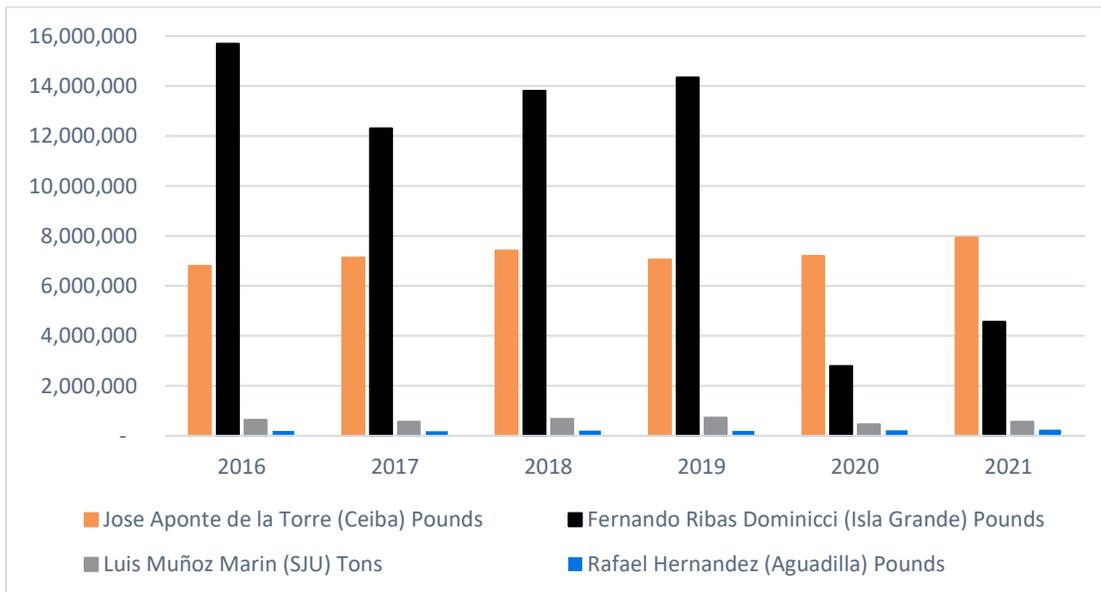
Source: Ports Authority, Monthly Operational Report FY2018-2019 to FY2022-2023

Figure 8: Puerto Rico Principal Cargo Airports



Source: Ports Authority, Monthly Operational Report FY2018-2019 to FY2022-2023

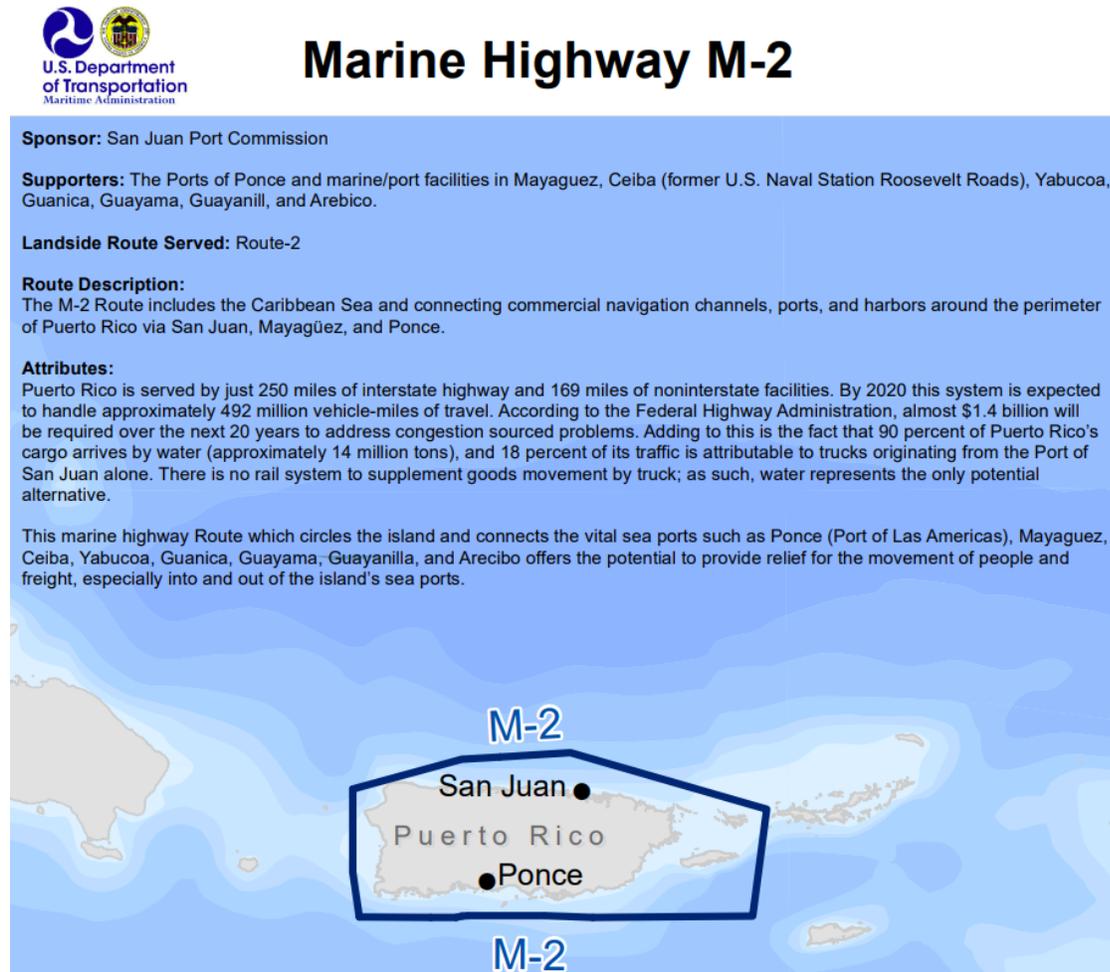
Figure 9: Puerto Rico Other Cargo Airports



Source: Ports Authority, Monthly Operational Report FY2018-2019 to FY2022-2023

In addition to the seaports across the island, there is a new marine-based freight network (“Marine Highway”) emerging in the United States: “The Marine Highway system currently includes 29 “Marine Highway Routes” that serve as extensions of the surface transportation system. Each all-water route is designated by the Secretary and offers relief to landside corridors suffering from traffic congestion,

Figure 11: Marine Highway M-2 Route



Source: US Department of Transportation

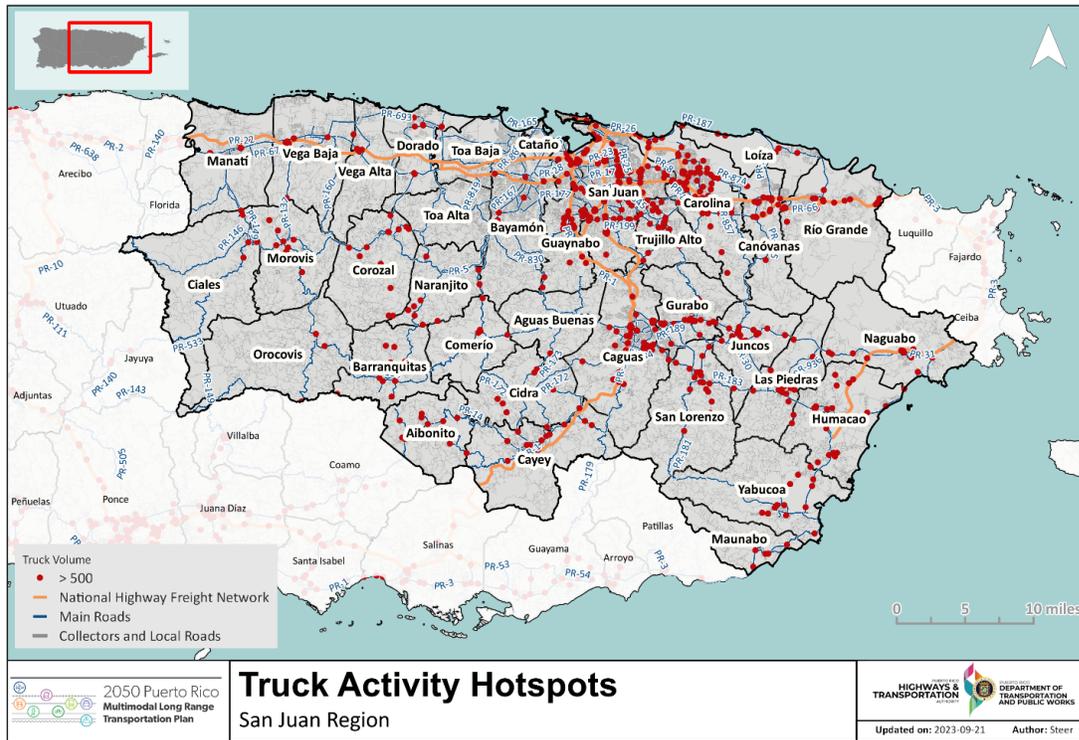
Regional Road Freight Network

The road freight network facilitates the movement of goods once received on the island. With San Juan having the largest airport and seaport on the island, regional distribution of goods stems primarily from the San Juan TMA.

Defined by the FHWA, the road freight network is primarily the interstate system, in addition to some local principal arterials in the San Juan TMA and other minor arterials that provide access to other urban areas / airports / seaports across the island.

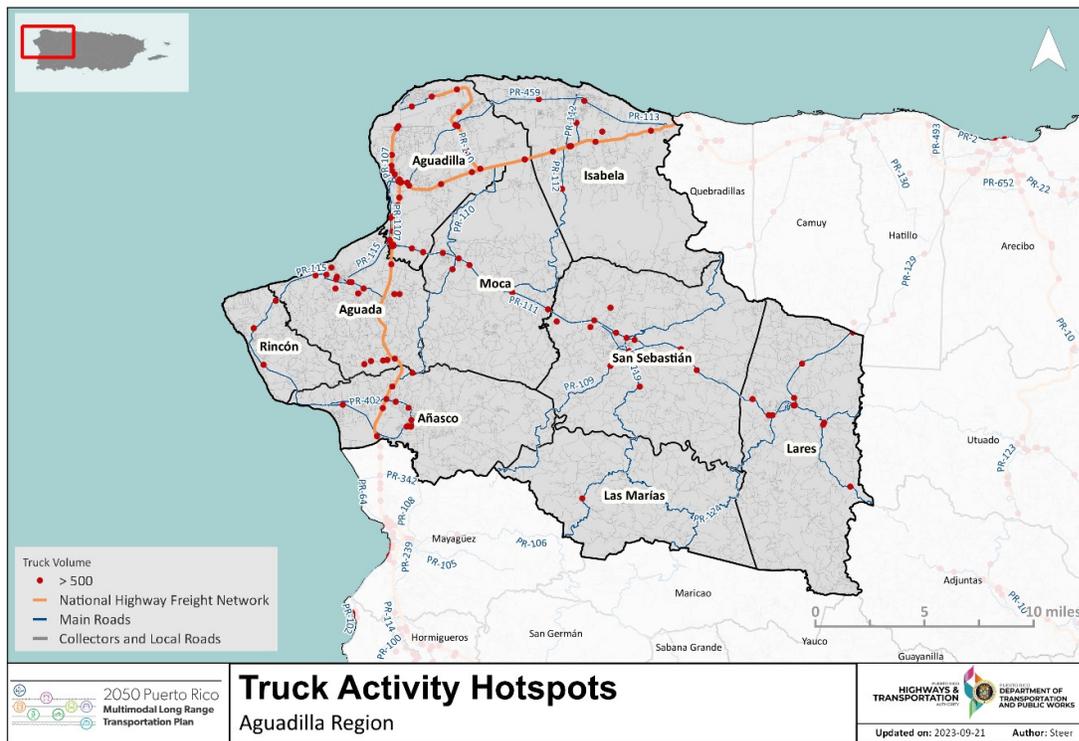
Overall, vehicle traffic (trucks) has increased on the primary interstate highways, as well as around ports and industrial zones. This has contributed to hot spots along sections of the road where traffic is operating at or over the capacity of the road. These hotspots are largely concentrated in the San Juan and Aguadilla TMAs, as well as along the interstate system and other local principal and minor arterials throughout the island. A regional map of hotspots is presented in Figure 5, with network hotspots specific to the San Juan and Aguadilla TMAs presented below in Figure 12 and Figure 13, respectively.

Figure 12: Freight Network Hotspots in the San Juan TMA



Source: Federal Highway Administration, Office of Freight Management and Operation, National Highway Freight Network, 2022 and U.S. Geological Survey, National Geospatial Technical Operations Center, 20230815, USGS National Transportation Dataset (NTD) for Puerto Rico (published 20230815) Shapefile: U.S. Geological Survey.

Figure 13: Freight Network Hotspots in the Aguadilla TMA



Source: Federal Highway Administration, Office of Freight Management and Operation, National Highway Freight Network, 2022 and U.S. Geological Survey, National Geospatial Technical Operations Center, 20230815, USGS National Transportation Dataset (NTD) for Puerto Rico (published 20230815) Shapefile: U.S. Geological Survey.

Urban Freight And Logistics

The urban and last mile freight sector is focused on the movement of goods within *urban* environments, with *last-mile* transportation activities being the final segment of a trip, typically between the last major mode (e.g. transit stop) or node (e.g. urban logistics hub) and the intended destination (e.g. residence). Examples of urban / last mile freight efforts can take the form of urban logistics hubs, sustainable last mile delivery vehicles, as well as infrastructure to support these vehicles (e.g. bike lanes and charging infrastructure for Zero Emission Vehicles), curbside and parking management strategies, and multi-sector collaboration to foster sustainable last mile delivery businesses, among others³⁸.

On a global basis, rapid advancements in this sector have been at least in part driven by a shift in consumer behaviour / supplier response during the pandemic, such as the uptake in E-Commerce and a growth and shift in the types of goods being demanded. **Importantly, however, a shift in in technological innovation and diversification of freight / logistics business models was already underway prior to the pandemic³⁹. That said, the evolution and advancement of this sector looks different across the world as the challenges, opportunities, and constraints (e.g.: legislation, infrastructure) vary across cities.** For these reasons, planning and policy-making for this sector looks different in different places. For example, some jurisdictions have opted to develop stand alone plans and policies related to urban and last mile freight, and others have opted to embed it into other transportation planning efforts, such as in curbside and parking management strategies, sustainable urban mobility plans, and wider multi-modal strategic plans.

Only one sustainable last mile delivery service provider was identified in San Juan⁴⁰. This company offers last-mile logistics services with electric cargo bike along Santurce, with additional arrangements to Hato Rey, Old San Juan, and Isla Verde (in Carolina).

A detailed inventory of current or planned efforts relating to urban / last mile freight in Puerto Rico is recommended as, at the present time, the state of play is not well understood. This can be better understood in a variety of ways, including but not limited to:

- a stakeholder identification exercise to better understand the key players in the last mile industry in Puerto Rico
- a scan of relevant plans / policies to see the extent to which last mile freight has been incorporated.
- a study to better understand the challenges, opportunities, and constraints related to the uptake and advancement of urban / last mile freight in Puerto Rico could be undertaken to help develop and advance this sector across this island.

³⁸ Urban logistics hubs are generally located within an urban area to fulfil the 'last mile' of the supply chain. They comprise central sites for logistics operations which receive, sort, consolidate, and coordinate the delivery of goods to their final destination. This, alongside the use of low and zero emission vehicles / vehicle alternatives (e.g. e-cargo bike) helps reduce the number of delivery vehicle trips, enabling better management of congestion at peak times and a reduction in harmful emissions. "[The Potential for Urban Logistics Hubs in London](#)", 2020, Steer

³⁹ In Europe, several cities were exploring new ways of delivering goods, such as [Velocarrier \(Germany\)](#), an e-bike based delivery service and logistics business based on the consolidation of same-day, first-mile and last-mile shipments; innovating logistics schemes ([Brussels, Belgium](#)); and incorporating freight into their overall mobility strategy ([Budapest, Hungary](#)).

⁴⁰ Cargo Bike Solutions, Inc. (2023) Home Page Retrieved from: <https://www.cargobikesolutions.com/english-home>

Also unconfirmed is whether municipal-level curbside and / or parking management strategies designed to maximize mobility, safety, and access for a wide variety of curbside demands⁴¹ are currently in place or in development. For these reasons, it is assumed that like regional goods movement, urban goods movement also utilizes the road network and a mix of diesel-fueled ‘medium trucks’ and ‘heavy trucks’.

Freight Vehicles

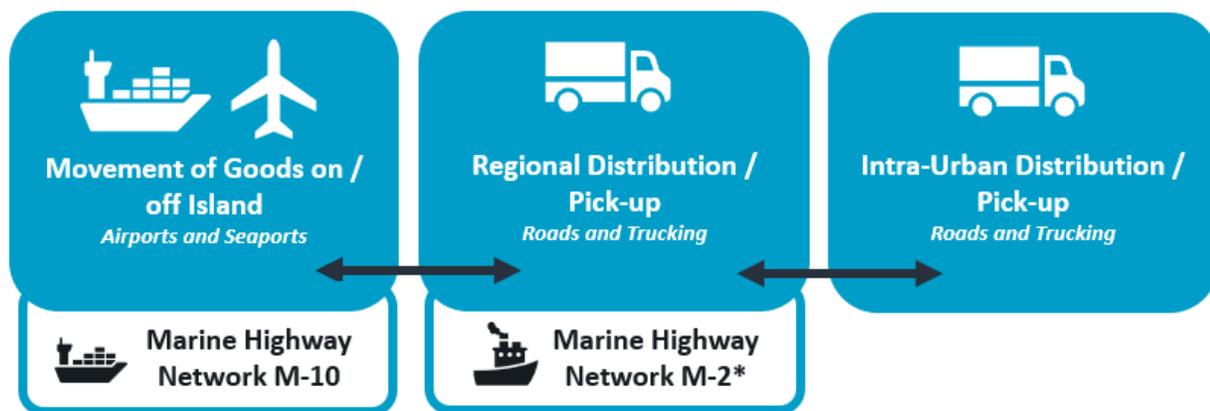
At present, diesel-fueled trucks remain the primary mode for moving goods regionally and within urban areas. This is combined with a lack of electric truck fleets, little-to-no regional or urban logistics hubs to help optimize fleets and movement, and no sustainable last-mile service alternatives. All of these factors combined will result in the road freight sector perpetually contributing to issues of congestion and air quality if the road-freight context in Puerto Rico remains unchanged.

The Current Goods Movement Process in Puerto Rico

Taking into consideration the above-mentioned information, the current process for moving goods to / from / within Puerto Rico is presented at a high-level below (see Figure 14).

In the context of Puerto Rico, it is critical to note how this process has and will continue to be disrupted by natural hazard / extreme weather events (e.g. earthquakes, hurricanes, flooding) which not only impact Puerto Rico’s infrastructure, but the welfare of its people and economy. Most recent hazard events to have disrupted this sector include, for example, Hurricanes Maria (2017) and Irma (2017), and the 2020 earthquake in the Island’s southwest. In addition to natural hazard / extreme weather events, other issues / challenges (discussed below) also serve as potential disruptors to this process if they remain unaddressed.

Figure 14: Goods Movement Process to / from / within Puerto Rico



*The extent to which the M-2 network is being utilized is currently unknown

⁴¹ [JTF Curbside Management](#)

2045 LRMTTP – Progress to Date

The 2045 Puerto Rico LRMTTP identified a series of freight-related interventions, including projects, strategies, and recommendations. These interventions, along with any corresponding progress have been summarized below in Table 8, and will help to inform the opportunities and recommendations included in this assessment.

Table 8: 2045 LRMTTP Freight Interventions Progress Update

Intervention	Detail	Status (Progress to Date)
Freight Network Extensions	<p>Travel demand analysis (considering 2016 levels of population and employment) was undertaken, to identify new freight corridors and freight corridors for improvement.</p> <p>Five new freight corridors were identified, with the largest being the PR-22 Extension to Aguadilla (27.63 miles).</p> <p>16 Freight corridors were also identified for improvement, with most of these corridors spanning Aguadilla and San Juan.</p> <p>Benefits identified from these extensions include:</p> <p>An optimized distribution of trucks on roadways: freight related vehicles move from minor, local roads to those offering better and most suitable capacity (such as expressways and major arterials).</p> <p>It is likely that this spreading of heavy traffic could result in positive effects on other road users, result in better LOS, more reliable travel times and ideally, improved road safety.</p>	No progress to date.
State Freight Plans	<p>To receive funding under the National Highway Freight Program (23 U.S.C. 167), the FAST-Act⁴² requires each state to develop a local freight plan, to be updated at least every 5 years.</p> <p>The plan must cover a 5-year forecast period, and must:</p> <ul style="list-style-type: none"> Assess the condition and performance of the networks Detail the State’s freight planning activities and investments (both immediate and long-range), with a list of priority projects. Identify barriers to improved freight transportations and opportunities to improve connectivity and performance. 	No progress to date.

⁴² The Fixing America's Surface Transportation Act (FAST-Act) is a Federal law that provides long-term funding certainty for surface transportation improvements. The FAST-Act includes several provisions to improve, maintain, and support the condition and performance of the national freight network. This includes specified goals, related to the condition, safety, security, efficiency, productivity, resiliency, and reliability of freight networks, and in the reduction of adverse environmental impacts related to freight.

Intervention	Detail	Status (Progress to Date)
State Freight Advisory Committees	The FAST-Act requires DOT to encourage each State to establish a local Freight Advisory Committee , comprising a representative cross-section of public and private freight stakeholders. The role of a State Freight Advisory Committee is to: Provide advice to the State on freight-related priorities, issues, projects, and funding needs; Serve as a forum for discussion and information-sharing between private and public sectors; Communicate and coordinate regional priorities with other organizations; Participate in the development of the freight plan of the State.	No progress to date.
Complete and Enhance Freight Network (Strategy)	Alongside the Freight Network Extensions identified, the 2045 LRMTTP recommended additional improvements to the freight network, including: Improving the Mayagüez to Aguadilla corridor Improving cargo services to Vieques and Culebra. Completing PR-10; PR -53 Improving roads providing access to/from ports and distribution centres to the strategic highway network.	Improvements to cargo services to Vieques and Culebra appear to be ongoing ⁴³ .
Congestion Reduction (Strategy)	The 2045 LRMTTP identified that strategies to reduce congestion on the strategic highway network would benefit the freight network. CMPs were therefore developed, and include the following objectives: Monitor and evaluate performance of multimodal transportation system; Identify the causes of congestion; Identify and evaluate alternative actions that provide information supporting the implementation of actions; and Evaluate the efficiency and effectiveness of implemented actions.	Congestion Management Processes for San Juan and Aguadilla TMAs have been developed.
Transportation Demand Management (related to Congestion Reduction strategy)	The intention of TDM is to help alleviate travel congestion through lower cost means than major capital investments for physical system capacity. Additionally, TDM provides strategies to increase shared and non-motorized forms of transportation, while addressing the need to reduce congestion and air pollution. As TDM is clearly an integral component of congestion reduction, TDM measures have been included in the CMPs developed for the San Juan and Aguadilla TMAs, however, freight-specific TDM measures have not currently been identified.	CMPs for San Juan and Aguadilla TMAs have been developed and include TDM as a component of the plan. However, no specific congestion-management projects have been identified to date, and none of the identified TDM strategies currently impact goods movement.
Resilience (Strategy)	For the first time, the 2045 LRMTTP incorporated a vulnerability assessment based on the FHWA's 2017 Vulnerability Assessment and Adaptation Framework. This assessment was mainly triggered	The 2045 LRMTTP includes a vulnerability assessment,

⁴³ "HMS Ferries Adding New Cargo and Passenger Vessels", The Weekly Journal, August 25th, 2021.

Intervention	Detail	Status (Progress to Date)
	<p>by the effects of Hurricane Maria on the transportation infrastructure and focused on floods and landslides.</p> <p>A more comprehensive assessment should be designed to include additional risk factors and adaptation measures. The assessment should also be expanded to include design / construction-related considerations as these considerations play a key role in infrastructure resilience.</p>	<p>however, it is recommended this be expanded / made more comprehensive.</p>
Intelligent Transportation	<p>It is important that Puerto Rico continues to build on the progress made with ITS (primary focus being on congestion management in key corridors and on non-car mode trips to influence behavior change) and identify opportunities for ITS to improve the goods movement process across the island. For example, Intelligent Communication Technologies have been observed to enhance supply chain performance, contributing to three main functions related to freight: resource management; ports and terminals operations management; and freight and vehicle tracking and tracing⁴⁴.</p> <p>New modes, such as Transportation Network Companies (TNCs), electric bike share, electric scooters etc. are mixing with more traditional modes such as transit, providing a much broader 'transportation ecosystem' to the user. In many cases, these new services are providing 'first/last mile' solutions for riders who live a distance from transit stops and stations. An opportunity therefore exists to expand this type of service into the goods movement sector as a last-mile urban delivery / pick-up service.</p>	<p>The extent to which ITS technologies are impacting the goods movement process is currently unconfirmed.</p> <p>No known last-mile services (intelligent or otherwise) currently exist.</p>
Electrification	<p>The emissions from on-road fleets (light duty cars and trucks as well as heavy-duty trucks), reached peak levels during the 2000-2010 decades and are being predicted to fall over time. However, despite this prediction, reductions are not sufficient to reach the desired goal which is to have emission levels comparable to 1990 levels. In addition, the most significant driver for the reductions in emissions: new fuel efficiency standards, are not predicted to continue up to 2050. Therefore, additional measures will need to be taken to continue to help reduce vehicle-related emissions. Examples include:</p> <p>Provision of vehicle charging infrastructure, specifically rapid charge points for the commercial sector;</p> <p>Easing of the permitting process for the construction of private charging facilities;</p> <p>Establishing or enhancing subsidies for charging equipment and/or vehicles; and</p> <p>Enhancing tax credits for electric vehicles purchases.</p>	<p>The extent to which electric truck fleets currently exist or are incentivized is unconfirmed.</p> <p>Charging infrastructure does exist in Puerto Rico, but whether it has the capacity to charge trucks is unconfirmed.</p>

⁴⁴ [Mirzabeiki, V \(2013\)](#)

Intervention	Detail	Status (Progress to Date)
	Recent advancements in the electrification of goods movement vehicles (e.g. heavy trucks) has improved the ability / willingness of company's to transition their fleets away from diesel and towards electric. ⁴⁵	

Issues and Opportunities

Taking into consideration the findings discussed above, several key issues and challenges, as well as opportunities related to current and potential future goods movement conditions in Puerto Rico are identified and summarized in Table 9 below. To ensure alignment with the 2050 LRMTTP, Table 9 also **Error! Reference source not found.** indicates how each opportunity may support wider 2050 plan goals and objectives.

Table 9: Issues, Challenges, and Opportunities

Issue / Challenge	Description and Example	Opportunities	Alignment of Opportunities with 2050 Plan Goals / Objectives
Natural Hazards / Extreme Weather Events	<p>Puerto Rico is highly susceptible to natural hazards, which damages freight-related infrastructure (e.g. seaports, airports, roads) and the movement of goods.</p> <p>An example of this was when the 2020 Southwest Puerto Rico Earthquake Sequence compounded damage caused by Hurricane Maria (2017).</p> <p>The Rafael Cordero Santiago Port of the Americas was weakened by the impacts of the hurricane, and further damaged by the earthquakes, delaying construction of the mega port.</p> <p>The Port of San Juan suffered major damage and disruption from the 2017 hurricane.</p>	<p>Comprehensive Vulnerabilities Assessment that expands current analysis and adaptation framework.</p> <p>Workforce capacity building, including truck drivers, to address logistics challenges ahead of the development and roll out of recovery plans.</p> <p>Scenario planning to assist with preparedness for unprecedented / rapid systems change.</p> <p>Land use assessments to identify more resilient locations to provide new/ retrofitted infrastructure.</p>	<p>Improve transportation system's safety and security and its ability to provide support when emergencies occur (Goal A, Objective 5).</p> <p>Reduce transportation infrastructure's vulnerability for it to withstand extreme weather events through resilient infrastructure (Goal B, Objective 5).</p>

⁴⁵ [Trends in heavy-duty vehicles, IEA Global Outlook 2023](#)

Issue / Challenge	Description and Example	Opportunities	Alignment of Opportunities with 2050 Plan Goals / Objectives
<p>Congestion</p>	<p>The road network routinely exceeds its capacity as a result of too many vehicles and trucks being on the road. As a result, Puerto Rico sees sustained congestion and air quality issues.</p> <p>The San Juan TMA in particular is observed to have some of the worst congestion / hot spots in the network given it is the largest metropolitan area on the Island, and home to the Islands' largest airport and seaport.</p> <p>Capacity constraints on inter-modal connecting nodes, and/or a configuration that limits network redundancy can create or exacerbate freight bottlenecks.</p> <p>A recent example of this was post-hurricane Maria, where supply chain challenges arose in Puerto Rico centered around the Port of San Juan. While cargo was able to make it to the port, due to blocked roads and shortages of trucks and drivers, many goods could not be transported out of the port area.</p>	<p>Logistics hubs and ITS technologies can work to help to optimize fleets and movement of goods, which can then help to reduce congestion along the network as delivery vehicle trips are reduced.</p> <p>Hubs can be located at a regional or urban scale to assist with the (re)distribution of goods.</p> <p>Urban logistics hubs pair well with sustainable last-mile service alternatives (e.g. cargo bikes) to reduce the amount of diesel-fueled medium / heavy trucks in cities, helping to reduce air and noise pollution as well as road and curbside congestion (provided bikes do not have to operate in mixed traffic, and have, at least to some extent, access to dedicated cycling infrastructure).</p> <p>Policies around the timing of goods movement, such as through off-peak and nighttime delivery requirements / incentives can help to reduce congestion as it re-assigns truck traffic to a time when roads are less busy.</p> <p>The Marine Highway Network is an effective alternative to road-based trucking for regional distribution as it capitalizes on underutilized waterways, moving goods more efficiently and, to some degree, more sustainably: ships, like trucks, have their own environmental footprint as they require a fuel source and contribute to emissions/pollution unless powered electrically or by more sustainable bio-fuels⁴⁶. That said, removing diesel-fueled trucks from the road nonetheless helps</p>	<p>Ease traffic delays and travel time through accurate congestion management programs (Goal A, Objective 1)</p> <p>Reduce GHGs, energy consumption, and carbon footprint emittance; promote "smart growth", livable communities and improve air quality (Goal B, Objective 2)</p> <p>Facilitate the efficient movement of freight, business, and tourism activities to achieve economic competitiveness (Goal D, Objective 1)</p>

⁴⁶ [Making waves: Electric ships are sailing ahead](#)

Issue / Challenge	Description and Example	Opportunities	Alignment of Opportunities with 2050 Plan Goals / Objectives
		<p>tackle pollution and congestion issues. Importantly, the logistics of shipping / receiving goods by ships in other ports would have to be managed accordingly.</p>	
Connectivity	<p>In Puerto Rico, the road network is dominated by circumferential routes around the perimeter / coast of the country. Subsequently, inland locations, away from metropolitan centers along the coast, are more isolated, and can face more severe problems with delivery of critical goods.</p>	<p>Expand the road network and improve efficiency / communication of routes using ITS technology.</p> <p>Expand the regional road and sustainable transport network, adding infrastructure not just in cities, but between them.</p> <p>Expand network redundancies.</p> <p>Add truck only lanes.</p>	<p>Improve connectivity between the Island's fundamental activity Regions, such as, but not limited to employment centers, touristic areas, and dense residential districts (Goal C, Objective 1).</p> <p>Focus in providing commercial connectivity throughout the Island (Goal D, Objective 3)</p>
Traffic Safety / Accidents	<p>According to the 2022 Puerto Rico Highway Safety Plan, hundreds of people are killed and thousands injured from traffic crashes. Although, a reduction of less than 300 between 2016 to 2020 has been achieved, still road users' behaviors are the biggest problem and the hardest to change. Over the last years, alcohol-impaired driving and pedestrian fatalities have represented two-thirds of total traffic fatalities in Puerto Rico. While the relationship between accidents and freight are not discussed in this report specifically, accident-caused delays undoubtedly impact the goods movement process. As well, medium and heavy trucks being the size that they are would be more dangerous to other road</p>	<p>Better road safety design that accommodates the needs of all users, particularly people who are most vulnerable (e.g. people on foot).</p> <p>Capacity / resource improvements to better manage this issue-area.</p> <p>Reducing the overall number of vehicles would help reduce congestion, as well as potentially mitigating conflicts between users in certain locations.</p>	<p>Improve transportation system's safety and security and its ability to provide support when emergencies occur (Goal A, Objective 5).</p>

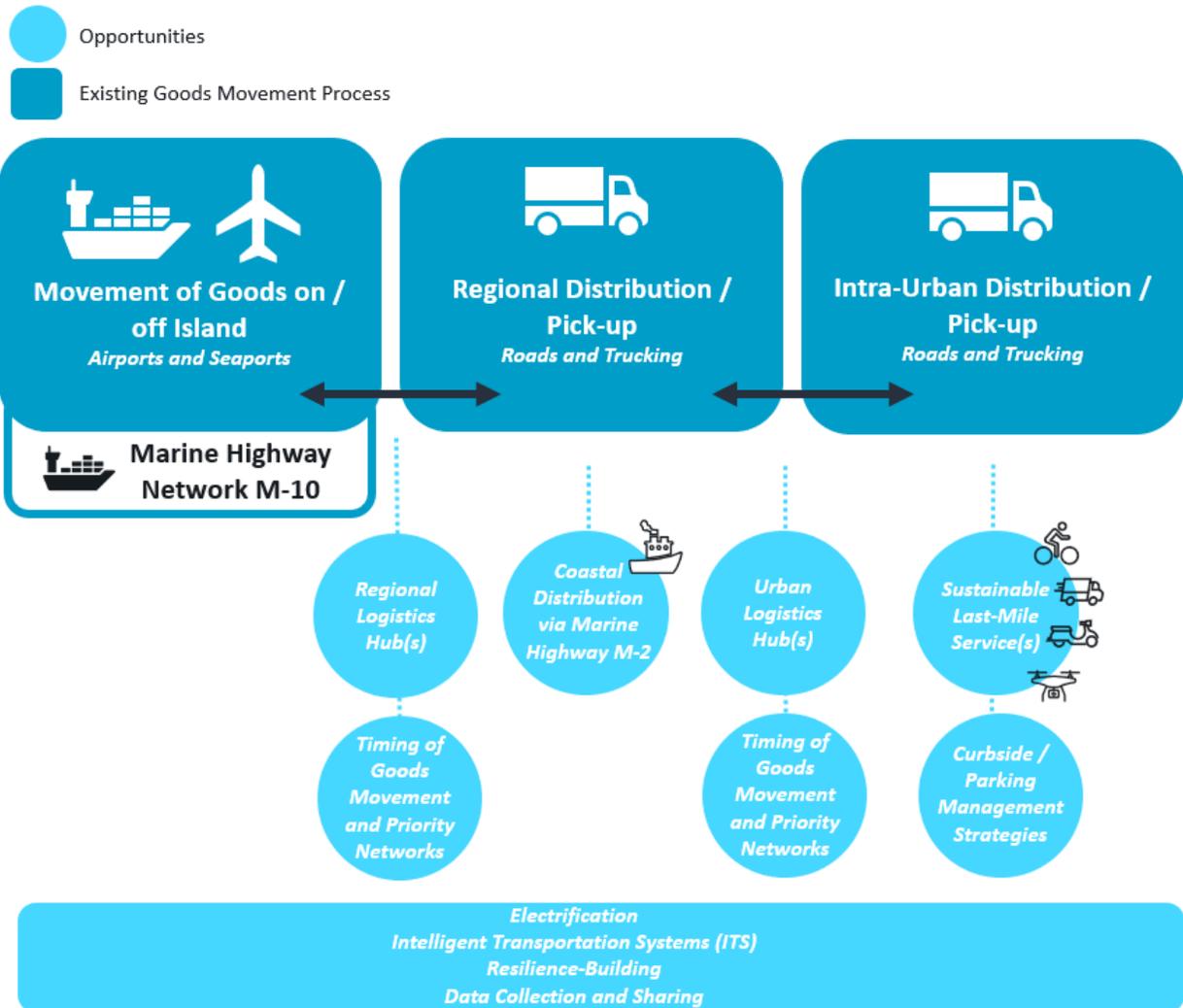
Issue / Challenge	Description and Example	Opportunities	Alignment of Opportunities with 2050 Plan Goals / Objectives
	<p>users if ever involved in a crash as compared to other vehicle types.</p> <p>Some of the state's problems that hinder traffic safety are funding constraints and budget cuts, out of date technology and data gathering, VMT delayed actualization, among other situations. All these limits the traffic data analysis process, which depends on multiple microanalyses of different databases, manual reports, and data (where entries are often delayed).</p>		
Air Quality	<p>As diesel-fueled trucks are still the primary mode for regional and urban goods movement, the emissions from these trucks, particularly when idling along congested corridors / in cities, has a notably negative impact on air quality.</p>	<p>With advancements in truck electrification technology, it is becoming more feasible for trucking companies to transition away from diesel-fueled trucks towards electric. Currently, Puerto Rico has some charging infrastructure on the Island, which could be outfitted (if necessary) for truck charging. Expansion of charging infrastructure is also possible.</p> <p>In addition to the electrification of fleets, there is a role to be played by more sustainable transport modes (e.g. cargo bikes), particularly for the urban 'last mile', as well as TDM whereby the implementation of measures can help reduce the number of trucks needed on the road.</p>	<p>Reduce GHGs, energy consumption, and carbon footprint emittance; promote "smart growth", livable communities and improve air quality (Goal B, Objective 2)</p>
COVID-19 Pandemic	<p>The COVID-19 pandemic led to unprecedented changes to nearly all aspects of life.</p> <p>In terms of how COVID-19 impacted the goods movement sector / process, more goods were being demanded and more frequently. Buying habits / patterns shifted, particularly with lockdowns and people working from home.</p>	<p>Logistics hubs and ITS technologies to help to optimize fleets and movement of goods.</p> <p>Curbside / Parking Management Strategies</p> <p>Expand / improve safety conditions of the road and sustainable transport network.</p> <p>Invest Puerto Rico (a public-private partnership), in collaboration with the Department of Economic Development and</p>	<p>Improve transportation system's safety and security and its ability to provide support when emergencies occur (Goal A, Objective 5).</p> <p>Improve connectivity between the Island's</p>

Issue / Challenge	Description and Example	Opportunities	Alignment of Opportunities with 2050 Plan Goals / Objectives
	<p>Unprecedented supply chain issues resulted from the unprecedented demand for goods. As well, how goods were being delivered (and picked-up) changed, from contactless / curbside delivery to a surge in bicycle and motor-cycle delivery modes.</p> <p>Congested roads were, in some places, made worse, although with a reduction in traffic from lockdowns this was temporarily offset. Also increased was the demand for sustainable transport infrastructure to accommodate bike delivery services, as well as curbside / parking space.</p>	<p>Commerce (DEDC)⁴⁷, identified opportunities for public / private coordination for supply chain development in Puerto Rico, post COVID-19 pandemic including:</p> <p>Maintain stability of Island’s supply chain connectivity in terms of price, frequency, and security between mainland US resulting from pandemic.</p> <p>An increase in tourism to the Island can help support increased air cargo capacity.</p>	<p>fundamental activity Regions, such as, but not limited to employment centers, touristic areas, and dense residential districts (Goal C, Objective 1).</p> <p>Facilitate the efficient movement of freight, business and tourism activities to achieve economic competitiveness (Goal D, Objective 1)</p> <p>Focus in providing commercial connectivity throughout the Island (Goal D, Objective 3)</p> <p>Encourage potential public-private collaborations (Goal D, Objective 2)</p>
Data Collection / Sharing / Analysis	<p>There is an overall lack of freight-related data collection / sharing / analysis in Puerto Rico, from ports, to regional road, to cities and curbs. As well, there is a lack of data related to freight-adjacent sectors such as traffic safety, as well.</p>	<p>An opportunity exists to collect freight-related data both through ports and through freight vehicles (ships or trucks) and their companies. Having consistent and up-to-date datasets is critical for effective goods movement planning as it can provide insight into issue areas, and therefore, what may be an effective method for tackling said issues.</p> <p>Data collection requirements can be incorporated into licensing / permitting processes, particularly for new gig economy businesses.</p>	<p>Facilitate the efficient movement of freight, business and tourism activities to achieve economic competitiveness (Goal D, Objective 1)</p>

⁴⁷ “[Puerto Rico's Path Towards Competitiveness](#)”, presentation by DEDC, published by Puerto Rico Chamber of Commerce, 2021.

Given the issues and opportunities discussed above, a revised version of the goods movement process diagram is presented in **Error! Reference source not found.** below, and highlights where the identified opportunities may be woven into the existing goods movement process.

Figure 15: Goods Movement Process Opportunities



Conclusions and Recommendations

Continue progressing and build upon the recommendations identified in the 2045 plan (see Table 10)

Table 10: 2045 LRMTTP Freight-related Recommendations

2045 LRMTTP Recommendations (Freight)	Description
Congestion	Expand / Strengthen the Congestion Management Process (currently in place for San Juan and Aguadilla TMAs) Address bottleneck, capacity improvements, and demand management measures that can enhance access and mobility.
Resilience	Expand and strengthen the existing Vulnerability Assessment developed after Hurricane Maria in 2017.
Scenario Planning	Preparedness for unprecedented / rapid systems change