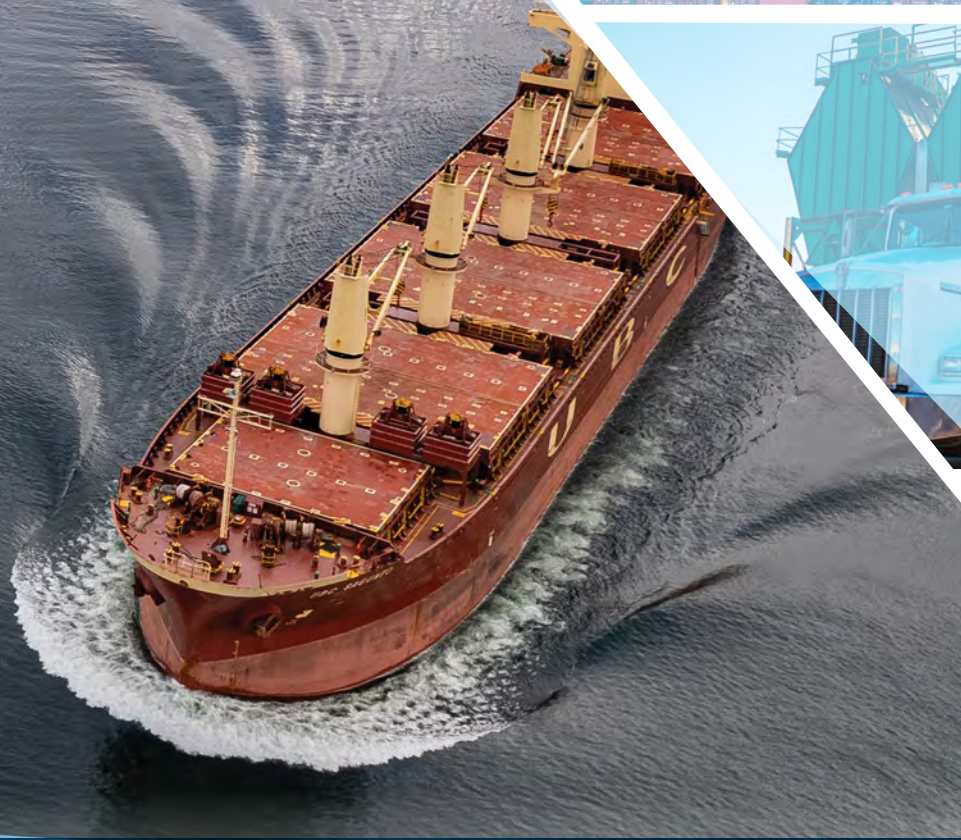
Prepared for:

WASHINGTON PORTS

WASHINGTON STATE FREIGHT MOBILITY STRATEGIC INVESTMENT BOARD

WASHINGTON MARINE CARGO FORECAST 2024

TECHNICAL APPENDIX



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Introduction

This Technical Appendix provides a detailed discussion of sources and methods for the *Washington Marine Cargo Forecast*, prepared for Washington Public Ports Association (WPPA) and the Washington State Freight Mobility Strategic Investment Board (FMSIB). The main report is available at:

www.washingtonports.org/publications-guides

Data Sources

The marine cargo forecast utilized a wide range of federal, state, local (port), and private vendor data sources. This section details these sources by category and purpose.

Trade, Port, and Economic Data

U.S. Census Bureau: USA Trade® Online

USA Trade® Online provides detailed trade data compiled by the U.S. Census Bureau, offering comprehensive insights into U.S. import and export activities. The data is sourced from mandatory filings required by U.S. Customs and Border Protection (CBP) through the Automated Commercial Environment (ACE) system. It includes records of shipments categorized by commodity codes, trade partners, ports of entry/exit, and transportation modes.

The dataset is constructed through rigorous data validation processes to ensure accuracy, including reconciliation with CBP and partner government agencies. It is updated monthly, with reports typically lagging by 45 days to allow for quality control. Data is available at various levels of granularity, such as product-specific details based on the Harmonized Tariff Schedule (HTS) codes and high-level summaries by industry or region.

Reports are accessible in both raw formats and as pre-aggregated visual dashboards, providing stakeholders—like businesses, policymakers, and researchers—an essential tool for analyzing trade patterns, monitoring compliance, and identifying market opportunities.

DATA FORMATS

The U.S. Census Bureau reports bill of lading data in two formats: 1) port district imports and exports; and 2) state of origin and destination imports and exports. All series are available by HS and North American Industry Classification System (NAICS) codes. All series can be further queried based on total marine cargo value, containerized marine cargo value, total marine cargo metric weight, and containerized cargo metric weight, as well by trading partner country.

DATA CHALLENGES

There are several important limitations in U.S. Census Bureau trade data for the purposes of marine cargo forecasting. These issues needed to be resolved as part of the marine cargo forecasting process.

Data is not unified

In its current published format, the USA Trade® Online bill of lading data does not allow the user to query imports or exports based on the port of entry or exit AND the destination or origin of cargo. For example, it is not possible to query the amount of agriculture exports originating from North Dakota and exiting via the Port of Longview or Port of Kalama.

State of origin can be misleading for some commodities

USA Trade® Online defines the "state of origin" for commodity exports as the state where the goods begin their journey to the port of export. This is not necessarily the state where the goods are manufactured, produced, or grown. Instead, it is based on the location where the final movement of the goods originates.

For example, if goods are manufactured in one state but shipped from a distribution center in another state to the export port, the state of origin is recorded as the state where the distribution center is located. This designation aligns with the shipping documentation provided to U.S. Customs and Border Protection during the export process.

This can be misleading for several important commodities. For example, oil seeds exports (primarily soybeans and soymeal) are credited as Washington state exports based on this definition, even though the state does not produce oil seeds. In the case of wheat, Washington is an important producer, but total wheat exports credited to Washington include wheat transited via barge, truck, or rail to the state and consolidated with Washington state wheat, overstating wheat exports. Other notable examples include passenger automobile exports and corn exports.

Geographic coverage in data not always aligned with port territory

U.S. Census port data is reported by U.S. Customs district and port district. However, when analyzing public port-level activity, the geographic units are often too broad. For example, the Longview port district includes both the Port of Longview (public) but also the adjacent Weyerhaeuser private marine terminal. The port districts for Anacortes and Bellingham include the public ports but also private oil refineries in Skagit and Whatcom Counties.

U.S. Army Corp of Engineers: Waterborne Commerce Data

The U.S. Army Corps of Engineers (USACE) Waterborne Commerce Data series provides detailed statistics on the movement of goods and vessels on U.S. navigable waterways, and the primary source for U.S. domestic marine cargo flows.

The data series covers cargo shipments and vessel movements across inland waterways, ports, and harbors, including domestic, import, and export activities. Variables include information such as commodity type, tonnage, origin and destination points, vessel type, and traffic by waterway segment. Data is collected from shipping companies, port authorities, and vessel operators, who are required to submit reports under federal regulations. The data series is published annually, with some summary statistics released quarterly, but with a significant time lag; the latest available data is through 2022.

WISER Trade

The study team worked with private data vendor WISER Trade to construct a dataset that corrects for the disunity in the U.S. Census Bureau, which reports bill of lading port-level trade data by state-of-origin and by port of entry or exit, but separately as two unlinked data series. The WISER Trade dataset begins with the above two data series published by the U.S. Census Bureau, then applies a modeling approach to link the two series, allowing for estimates linking port of entry/exit with hinterland markets. For example, WISER Trade produces estimates showing the metric tonnage of international exports of manufactured goods produced in Illinois and exported through The Northwest Seaport Alliance.

In some cases, adjustments were made to the WISER Trade data to correct for the “state-of-origin” attributions. For example, in the WISER Trade data, nearly all wheat exports are attributed to Washington state, despite Washington growing only a small share of total wheat

exports credited to the state. The study team used the U.S. Department of Agriculture's Agriculture Census and annual surveys, along with industry and port input, to re-apportion wheat export origins by state.[i] These corrections were important for subsequent forecasting and modal split analysis.

U.S. Census Bureau: Merchandise Trade Statistics

Merchandise Trade Statistics provide detailed data on the trade of goods between countries, sourced primarily from customs declarations and government trade agencies. The statistics are typically categorized using Harmonized Tariff Schedule (HTS) codes, offering insights into specific products such as automotive units, parts, and other commodities. Data is available in various formats, such as aggregated trade values, quantities, and detailed transaction-level records. This resource is crucial for analyzing trade trends, evaluating economic policies, and identifying opportunities in international markets.

This data is published by national trade and statistical agencies, with coordination at the international level by organizations like the United Nations Statistics Division**,** World Trade Organization, and International Trade Centre. In the United States, the primary source is the U.S. Census Bureau, often in collaboration with U.S. Customs and Border Protection.

Port-Specific Data Sources and Reports

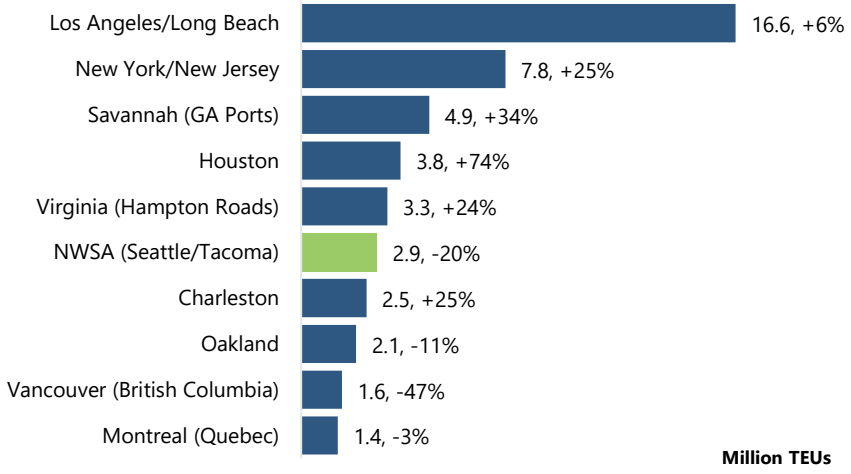
In addition to public agency data sources, the consulting team drew on a variety of port-specific reports and data sources. For example, The Northwest Seaport Alliance (NWSA) publishes quarterly and annual data on cargo volumes, including trade flows between the NWSA and Alaska and Hawaii. Similar reports on port-specific cargo volume reports were available from the ports of Everett, Longview, Kalama, Vancouver, and elsewhere, serving as critical resources to both validate and/or update cargo volumes and augment existing sources.

Industry Sources

AMERICAN ASSOCIATION OF PORT AUTHORITIES (AAPA) CARGO STATISTICS SOURCES SUMMARY

The American Association of Port Authorities (AAPA) publishes a range of cargo statistics to provide insights into the performance and activity of ports across the Americas. These statistics are compiled from data reported by member ports and other authoritative sources. For example, the AAPA publishes data gathered from the U.S. Bureau of Transportation Statistics and other sources on the largest North American container ports (**Figure 1**).

Figure 1. Largest North American Ports by Containerized Trade (TEUs), Imports and Exports, 2023 and Percent Change from 2016



Source: American Association of Port Authorities; Bureau of Transportation Statistics; American Journal of Transportation, 2024.

RAIL INDUSTRY REPORTS

BNSF and Union Pacific both publish annual reports on rail operations in Washington state, including track mileage, jobs, and other relevant information.

National and Global Macroeconomic Data and Forecasts

The following data sources were used in the production of the trade overview of the main report, including historic trends and growth projections.

INTERNATIONAL MONETARY FUND WORLD ECONOMIC OUTLOOK

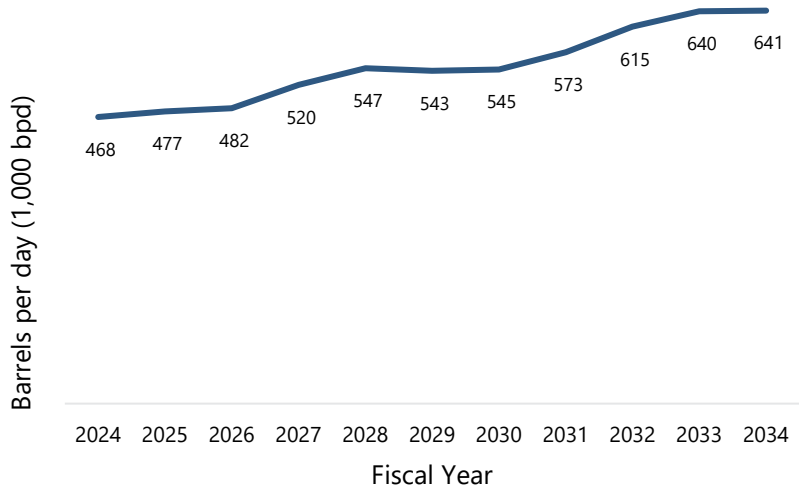
The International Monetary Fund (IMF) World Economic Outlook (WEO) is a flagship report providing analysis and forecasts on global economic developments. Published biannually (April and October), it assesses economic trends, growth prospects, and policy challenges across advanced, emerging, and developing economies. The report includes in-depth studies on topics like inflation, trade, and fiscal policies, alongside detailed regional and country-specific projections. The WEO serves as a key resource for policymakers, businesses, and researchers to understand and navigate global economic dynamics.

ALASKA NORTH SLOPE OIL PRODUCTION

Oil imports from Alaska remain among the largest commodities by volume handled at Washington state ports, primarily at the refineries in Skagit and Whatcom counties. The Alaska Department of Revenue provided data on Alaska North Slope oil production and outlook (**Figure 2**).

Alaska-to-Washington cargo volume is highly related to oil production on Alaska's North Slope (ANS), where nearly all of Alaska's crude production (95%) occurs. Much of the ANS crude produced gets transported to Washington refineries.[ii] By fiscal year 2034, ANS is expected to produce 641,000 barrels per day, up 37% from fiscal year 2024 (467,600 barrels per day), reflecting 3% annual growth.[iii]

Figure 2. Alaska North Slope (ANS) Oil Production Forecast, Fiscal Years 2024 - 2034

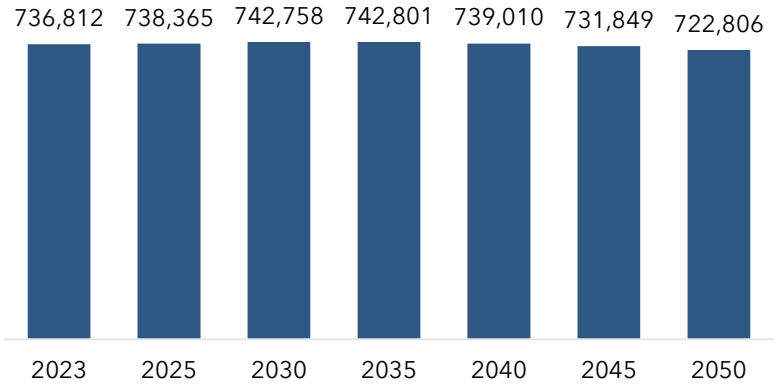


Source: Alaska Department of Revenue, 2024.

POPULATION FORECASTS

This report made use of multiple population forecasts. These forecasts were important for assessing long-term consumer demand and resulting freight demand. For Alaska, the primary forecast source was the Alaska Department of Labor and Workforce Development (**Figure 3**). For other states, the primary source was the University of Virginia's Weldon Cooper Center for Public Service (discussed further below under "Forecasts").

Figure 3. Alaska Population Projections, 2023 Actuals, 2025-2050 Forecasted

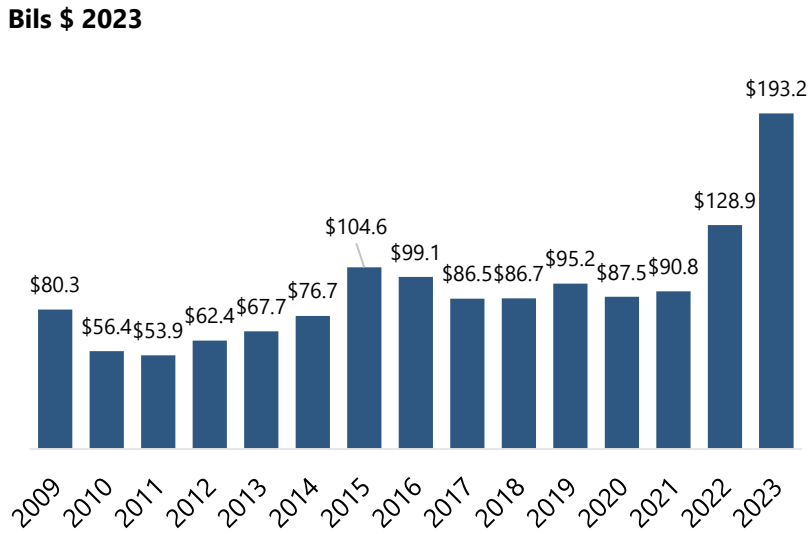


Source: Alaska Department of Labor and Workforce Development, 2024.

U.S. BUREAU OF ECONOMIC ANALYSIS

The BEA publishes data on gross state product, in total and by sector, representing an important input into establishing baseline economic conditions in hinterland markets for Washington state ports. The BEA also publishes annual data on new manufacturing construction in the United States. This data helps illustrate the recent surge in new investments and "re-shoring" of production, which may have long-term implications for shipping routes (**Figure 4**).

Figure 4. Manufacturing Construction in the United States, 2001-2023



Source: U.S. Bureau of Economic Analysis, 2024.[iv]

Interviews and Port Visits

The study team conducted 24 interviews over the course of the project with the following organizations, in addition to personally touring nine ports.

- BNSF
- Pacific Northwest National Laboratory (PNNL)
- Port of Anacortes
- Port of Bellingham
- Port of Benton
- Port of Chehalis
- Port of Clarkston
- Port of Everett
- Port of Grays Harbor
- Port of Kalama
- Port of Klickitat
- Port of Longview
- Port of Pasco
- Port of Port Angeles
- Port of Seattle
- Port of Tacoma
- Port of Vancouver
- Port of Walla Walla
- Port of Woodland
- The Northwest Seaport Alliance (NWSA)
- U.S. Maritime Administration (MARAD)
- Washington Association of Wheat Growers
- Washington State Department of Transportation (WSDOT)
- Washington Trucking Associations

Forecast Analysis

Long-term marine cargo volumes in this analysis are based on several key assumptions. First, cargo volumes are driven by industry-to-industry trade; industry growth drives trade growth; as trade grows, cargo volumes will also grow, albeit varying by the level of trade intensity (and freight demand) by industry. Trade is also a function of consumer demand—as populations increase, demand for consumer goods will also increase, with cargo demand growing as a function of overall consumer demand. Further, marine cargo flows depend on the modes of freight shipments. For example, some imports and exports may be more commonly shipped air cargo; an increase in overseas demand (for example, Asian demand for Washington state cherries) does not meaningfully impact overall marine cargo flows.

Freight Economy Model

The freight economy model captures industry-by-industry dynamics through the use of input-output models.

U.S. Bureau of Economic Analysis Benchmark Input-Output Model

The Benchmark Input-Output (I-O) Model, published by the U.S. Bureau of Economic Analysis (BEA), provides a comprehensive framework for analyzing the flow of goods and services in the U.S. economy. It captures the interactions between industries, final consumers, and international trade through detailed input-output tables. The model is constructed using data from economic censuses and surveys, updated every five years, and aligns with the North American Industry Classification System (NAICS). These tables are used to analyze economic dependencies, supply chain linkages, and the effects of policy changes, serving as a foundational tool for economic research and planning.

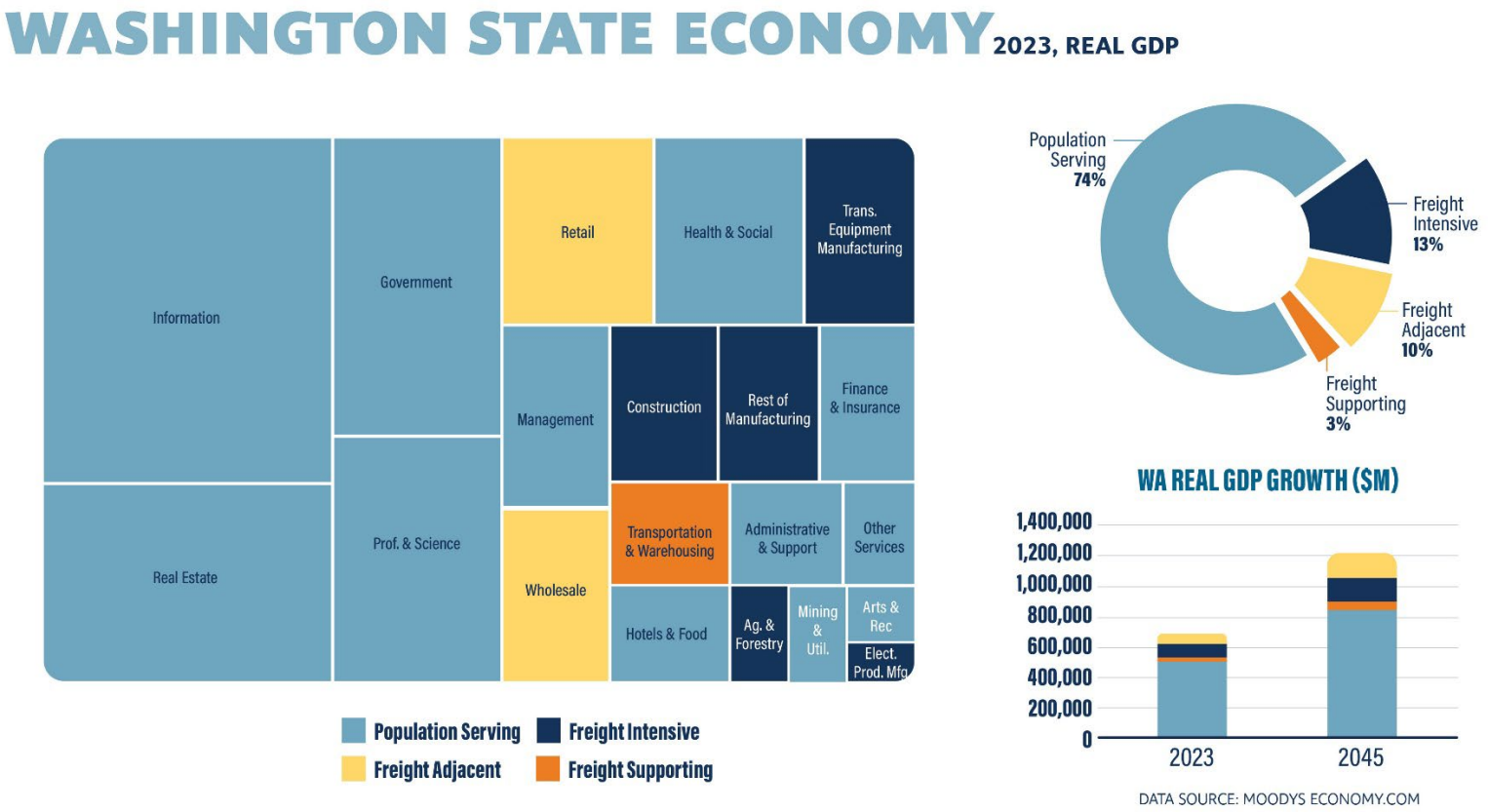
OECD Inter-Country Input-Output (ICIO) Tables

The OECD Inter-Country Input-Output (ICIO) Tables, published by the Organisation for Economic Co-operation and Development (OECD), provide detailed insights into global trade and production networks. The tables link national economies through trade in goods and services, mapping supply chains and the interdependencies of industries across countries. Constructed using national input-output tables, trade statistics, and other economic data, the tables are harmonized to ensure consistency and comparability across countries.

The ICIO dataset is used for analyzing value-added trade, global supply chains, and the economic impacts of policy changes. It is a critical resource for policymakers, researchers, and businesses to understand the interconnectedness of modern economies and evaluate strategies in a global context.

Freight intensity varies by industry. In **Figure 5** on the following page, Washington's economy is broken out by industry and freight-related activities. For example, "freight intensive" sectors include transportation equipment manufacturing, construction, other manufacturing, and agriculture and forestry (primarily for exports of raw commodities). These sectors combined represented 13% of Washington state GDP in 2023. "Freight adjacent" sectors include retail and wholesale—activities that import finished goods for distribution in the United States. These sectors represented approximately 10% of Washington state GDP in 2023.

Figure 5. Freight Intensity of Washington State's Economy



Economic Growth

In the first two phases, we established a marine cargo baseline (including trade volume flows between Washington state ports and U.S. hinterland markets) using the WISER Trade custom data series and the trade intensity by industry across the U.S. based on the freight economy model. In the third phase, we then applied growth rates by industry to project long-term marine cargo volumes through Washington state ports, using the following data sources:

Moody's Economic Forecast

The Moody's Economic Forecast, published by Moody's Analytics, provides forward-looking analysis and projections of economic trends at global, national, regional, and local levels. The forecasts are based on proprietary economic models that incorporate a wide range of inputs, including macroeconomic indicators, financial market data, and policy developments.

The reports cover key metrics such as GDP growth, employment, inflation, interest rates, and industry performance. Moody's Economic Forecast is widely used by businesses, policymakers, and financial institutions to assess economic risks, evaluate market opportunities, and guide strategic planning.

U.S. Census Bureau Quarterly Census of Employment and Wages

The Quarterly Census of Employment and Wages (QCEW), produced by the U.S. Census Bureau in collaboration with the U.S. Bureau of Labor Statistics (BLS), provides detailed information on employment, wages, and business establishments across industries. The data is collected quarterly and includes nearly all U.S. businesses covered by unemployment insurance, representing over 95% of U.S. jobs. QCEW data is organized by geography (national, state, county, and metro levels), industry (based on NAICS), and ownership type (private or public).

U.S. Census Bureau County Business Patterns

The County Business Patterns (CBP), published annually by the U.S. Census Bureau, provides detailed data on the economic activities of businesses across the United States at the national, state, county, and metro levels. The dataset includes information on the number of establishments, employment, payroll, and industry-specific metrics, categorized by the North American Industry Classification System (NAICS).

CBP excludes data on self-employed individuals, agricultural production workers, and most government employees, focusing instead on businesses with paid employees. It is a vital resource for analyzing local economic conditions, assessing market potential, and informing policy and investment decisions.

Population Growth by State

The Weldon Cooper Center for Public Service has released updated national population projections for all 50 states and the District of Columbia, covering the years 2030, 2040, and 2050. These projections, benchmarked against the 2020 Decennial Census data, anticipate a continued increase in the U.S. population, though at a decelerating rate.

The center produces state population forecasts by combining data from the 2020 Decennial Census with demographic trends such as birth rates, death rates, and migration patterns. They use statistical models to project future populations, accounting for state-specific growth dynamics and aging trends.

Domestic Cargo Forecast

Forecasted domestic cargo volumes were projected using an econometric model rather than the above-discussed freight economy model. Unlike for international containerized trade, there is no available data on the contents of domestic containers; information provided by the NWSA includes loaded and empty and inbound and outbound domestic containers, but no information on the contents inside. An alternative approach was thus employed to project long-term container trends.

Domestic cargo volumes were gathered from the U.S. Army Corp of Engineers Waterborne Commerce data series through the latest available year, 2022. The data was filtered for Washington state port waterways and for the traffic types "coastwise" (the majority of flows, representing trade with Alaska and Hawaii), "lakewise," and "internal." Historic domestic cargo volumes were regressed against historic GDP growth in Alaska (the majority of domestic cargo volume shipments) and Washington state. Forecasted GDP growth rates were then introduced to project future domestic cargo volumes by commodity category.

The forecast of containerized goods is based on a mixed method of either linear regression or an applied average annual growth rate, depending on the regression's continuity with historical trends. Both methods are built on access to historical data on port tonnage by commodity from the years 2005-2022 (omitting 2012 for data availability reasons). The forecasted decline in containerized goods is largely due to the forecasted decline in machinery/vehicles and parts. The machinery/vehicles and parts forecast uses the regression method and consistently declines over time, following years of historical volatility. The predictors for all regression-based tonnage forecasts are the forecasted state GDPs of both Alaska and Washington state in industries related to the forecasted commodity.

Total tonnage per future year was then summed based on the rate of containerization per U.S. Army Corp of Engineers STG commodity code. For example, some products, such as crude oil, have 0% containerization rate, while others, such as auto parts, are primarily containerized.

The future annual growth rates of containerized tonnage were then applied to historic domestic loaded TEUs handled at the NWSA to arrive at an initial projected TEUs. We then reviewed these rates and made manual adjustments to correct for potential outliers in future years.

Empty containers were projected by computing a historic weighted average of empty-to-loaded TEUs through the NWSA. This ratio was then applied to each forecast year.

Modal Splits Analysis

Marine cargo moves to and from Washington state ports through a variety of modes. These modal "splits" depend on several factors, such as the type of cargo (e.g., bulk, container) and the distance between the port and export origin or import final destination. Modal splits have important implications for the surface and riverway domestic cargo transportation system; a greater demand for wheat exports, for example, could be hindered by insufficient barge infrastructure, a common mode for domestic wheat shipments.

Interviews served as critical inputs for this analysis, combined with port-specific data on the arrival or domestic shipment of key commodities. In some cases, such as containers, estimates were largely based on data provided by The NWSA on shares of inbound containerized cargo by mode, including intact by rail, transload to rail, and truck only. The Port of Kalama provided detailed data on modal shares by major bulk commodities. Interviews with other ports, industry associations, rail representatives, and other stakeholders provided additional key inputs for this analysis.

[i] United States Department of Agriculture (USDA). *Census of Agriculture. National Agricultural Statistics Service*, [Year]. Available at: https://www.nass.usda.gov/AgCensus/; United States Department of Agriculture (USDA). *Annual Agricultural Survey*. National Agricultural Statistics Service, 2023. Available at: https://www.nass.usda.gov/.

[ii] U.S. Energy Information Administration. 2024. https://www.eia.gov/state/analysis.php?sid=AK.

[iii] Alaska Department of Revenue. Spring 2024 Revenue Sources Book. https://tax.alaska.gov/programs/programs/reports/RSB.aspx?Year=2024&Type=Spring

[iv] U.S. Bureau of Economic Analysis, Gross Domestic Product: Implicit Price Deflator [GDPDEF], retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/GDPDEF, August 8, 2024.