MAINE STATE RAIL PLAN RAIL

Rail System Use and Economic Profile

January 31, 2023

MaineDOT

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prepared for

MaineDOT

prepared by

CAMBRIDGE SYSTEMATICS

date

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1. INTRODUCTION

This memorandum explores the linkages between the demand for rail transportation and the Maine economy. These linkages are illustrated through an examination of the economic and socioeconomic factors driving demand for goods movement and intercity passenger travel, and the resulting utilization of Maine's rail network for freight and passenger transport. It further includes an assessment of the robustness and diversity of Maine's freight rail users, and explores industry trends and macro-economic factors affecting demand for rail transportation.

The memorandum is structured into four sections, which are as follows:

- Section 2.0 **Existing Freight and Passenger Rail Flows** identifies the existing usage of Maine's freight and passenger rail transportation system.
- Section 3.0 **Economic Profile** identifies the industry sectors which most significantly drive freight transportation demand and the socioeconomic elements that drive the demand for passenger transportation.
- Section 4.0 **Freight Rail Shipper Diversity and Concentration** identifies the robustness of freight rail demand by determining the number and concentration of traffic volumes between various shippers.
- Section 5.0 **Trends and Competitive Factors Affecting Rail** examines the underlying factors driving demand for future rail service and explores how the rail network is being used to transport freight and passengers.

2. EXISTING FREIGHT AND PASSENGER RAIL FLOWS

This section profiles recent historical and current usage of Maine's rail network for freight and passenger transportation. The rail freight profile assesses traffic densities, commodities handled, and markets served by the state's rail network. Similarly, Amtrak's Downeaster linking Boston, MA with Portland and Brunswick, ME, is reported using recent ridership and service performance data. Collectively these profiles demonstrate the current role of freight and passenger rail in Maine.

2.1 Rail Freight Profile

The Rail Freight Profile examines current rail freight tonnage levels and railcar activity and the flow of rail-transported commodities across Maine. Given the ongoing impacts of the COVID-19 pandemic on virtually all aspects of the US and global economies during 2020 and 2021, the Rail Freight Profile utilizes 2019 as the baseline year for examining existing conditions. Obviously, it is evident that the COVID-19 pandemic will impart permanent shifts in economic activity that will affect demand for goods transportation across all modes, including rail.

2.1.1 Data Sources & Methodology

The rail freight profile utilized the following sources:

» **Freight Analysis Framework version 5 (FAF5.2) Database**. The Freight Analysis Framework (FAF), produced through a partnership between Bureau of Transportation Statistics (BTS) and the Federal Highway Administration (FHWA), integrates data from a variety of sources to create a comprehensive picture of freight movement between 132 domestic and 8 international regions by all modes of transportation. Serving as the underlying foundation of FAF5.2 is the 2017 Commodity Flow Survey (CFS), which is augmented by international trade data from the Census Bureau, the Surface Transportation Board's (STB) Public Use Rail Waybill file, as well as data from agriculture, extraction, utility, construction, service, and other sectors. For each origin-destination pair, FAF provides estimates of tonnage and value by 2-digit Standard Classification of Transported Goods (SCTG) commodity classification, and mode. FAF5.2, the most recent FAF dataset, includes a 2017 base year, a backcast for 2020, plus forecasts for 2022, 2023, and in five year intervals onward from

2025 through 2050. The basis for the forecast included in FAF5.2 is a Q2 2021 macro-economic forecast from S&P Global.

- **Surface Transportation Board (STB) Confidential Carload Waybill Sample for Maine**.[1] The Association of American Railroads (AAR) collects a stratified sample of rail freight waybills annually for the Surface Transportation Board (STB) from railroads that terminated at least 4,500 revenue carloads annually for each of the prior three years, or which move five percent or more of any state's total rail traffic.[2] MaineDOT obtained and provided to the consultant the confidential version of the Waybill Sample, which includes detailed shipment data including origin city and county (SPLC), destination city and county, 7-digit Standard Transportation Commodity Code (STCC), equipment type, and tonnage for years 2005, 2010, 2015, and 2017-2020. This included all traffic that originated and/or terminated in Maine, as well as transited through the state.
- **Surface Transportation Board (STB) Freight Commodity Statistics.** The Class I railroads provide quarterly commodity statistics (QCS) to the STB 60 days after the end of a quarter and annual commodity statistics 60 days after the end of each year. The statistics report the annual carloads and tons shipped on each railroad by commodity. The consultant downloaded the individual annual commodity statistic reports and consolidated to summarize the commodities across all Class I railroads between the years 1981 to 2021.
- **S&P Global Commodity Value per Ton.** S&P Global provided the dollar value/ton by commodity on a four digit STCC basis.

Maine's proximity to the international border with Canada presents some challenges in properly interpreting the records appearing in the STB Waybill database. As part of the reporting of rail freight moves, the Surface Transportation Board (STB) requires railroads to report freight activity terminating within ten miles of an international border (labeled as "Transborder Flag"[3] in STB data). To properly determine whether traffic ended near the

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[1] The STB Carload Waybill Sample is available to State DOTs for a nominal cost on the basis of a written request and signing of confidentiality agreements.

[2] 49 C.F.R. § 1244.9

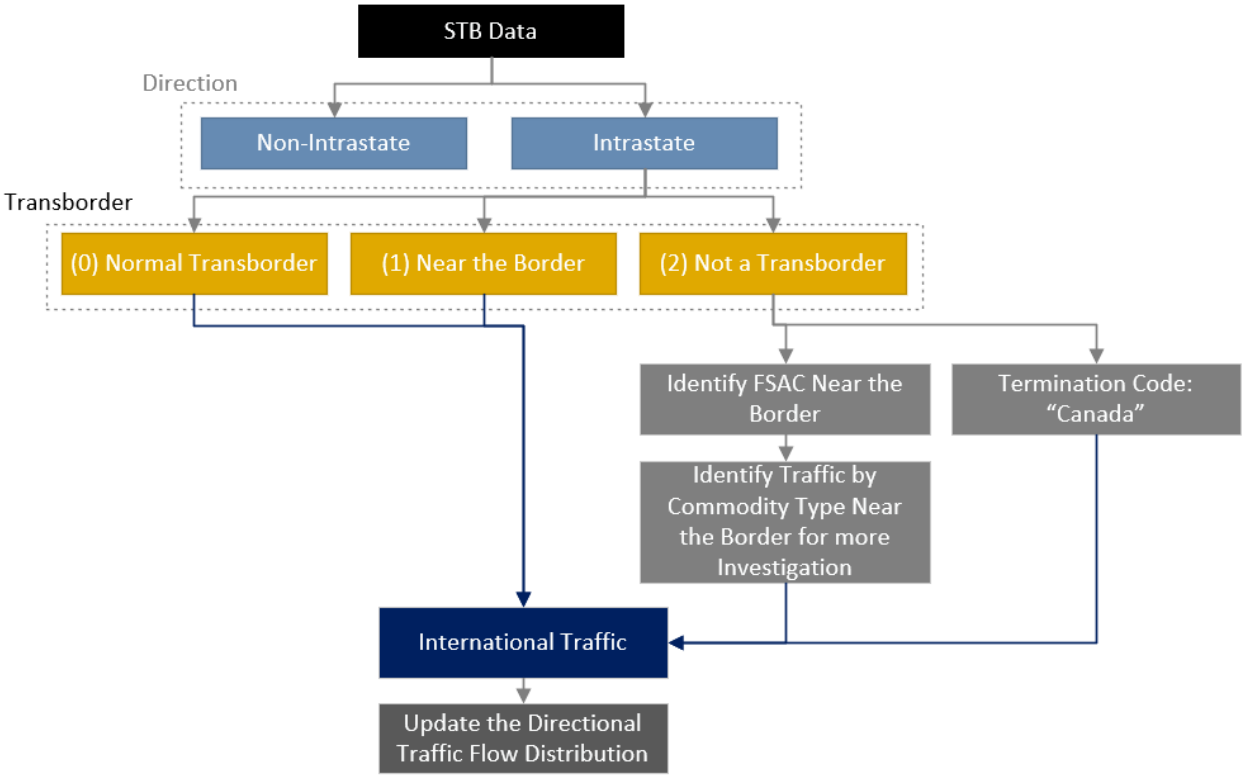
[3] Transborder Flag is a one-digit numeric field in STB data that "requires railroads to report information on either the entire international movement or treat the US portion of the movement as terminating at or near the border. Near the border is defined as either the last station or interchange point in the US that is within approximately 10 miles of the border, or the first station or interchange point in Canada or Mexico". 2019 STB Waybill Reference Guide - Page 75

- Transborder (0): is international traffic and the actual Origin and Destination is reported.
- Transborder (1): is international traffic but only the domestic part is reported.
- Transborder (2): in not international traffic.

Canadian border and stayed in Maine or continued across the border, the final destination for waybill entries terminating near the international border were validating using the following steps:

1. Intrastate waybills with "Transborder" flagged as normal transborder (0) or near the border (1) were identified as international movements.
2. Intrastate waybills with termination code equal to "CA: Canada were identified as international movements.
3. Freight Station Accounting Codes (FSAC code) near the Canadian border were identified. Intrastate shipments with transborder (2) and a termination FSAC near the Canadian border were manually reviewed to identify whether the move likely terminated locally or continued across the border.

Figure 2.1 Flow chart of Steps to Identify the international Freight movement

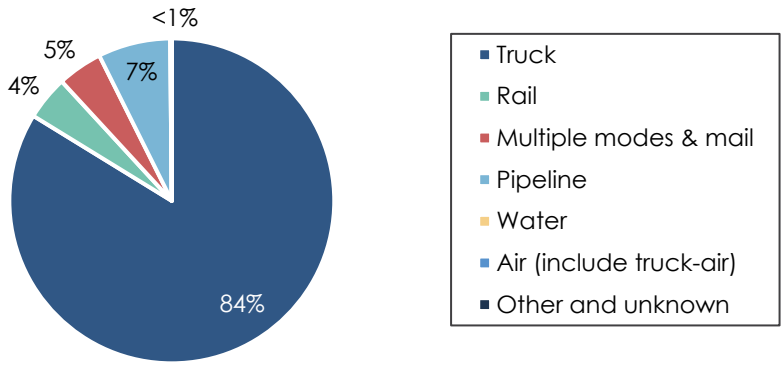


2.1.2 Total Freight Flows

FAF5.2 was used to estimate the mode share of rail in Maine. Figure 2.2 shows that a majority (84 percent) of goods movement in Maine is by highway. In 2017, modal share for rail stood at 4 percent on a tonnage basis, which is significantly lower than the national average of 10 percent.[4] At nearly 7 percent, liquids and gases moving by pipeline comprises the second largest mode of goods movement in Maine after highway. Most of this traffic entails trade with Canada.

Figure 2.3 shows Maine's freight distribution by mode on the basis of value. By this measure, truck dominates at 72 percent, while rail accounts for 2 percent of shipments in Maine. Beyond the truck mode, an outsized 23 percent of freight is transported via multiple modes and mail, i.e. U.S. postal service and integrated carriers such as FedEx and UPS.

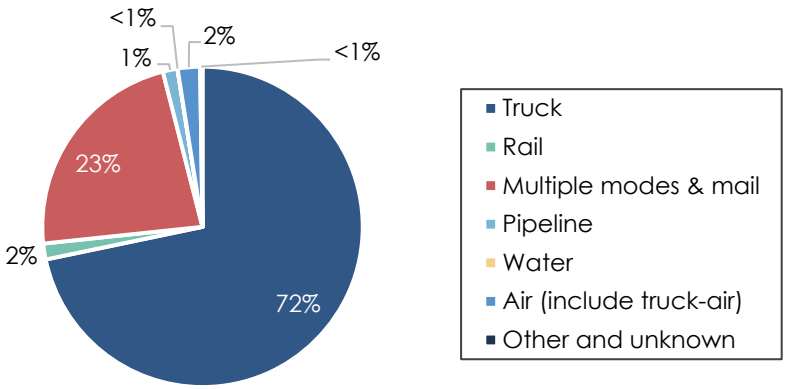
Figure 2.2 Freight Tonnage Distribution by Mode (2017)



Source: FAF5.2, 2017

[4] BTS, Freight Shipment by Mode 2017: bts.gov/topics/freight-transportation/freight-shipments-mode

Figure 2.3 Freight Value Distribution by Mode (2017)

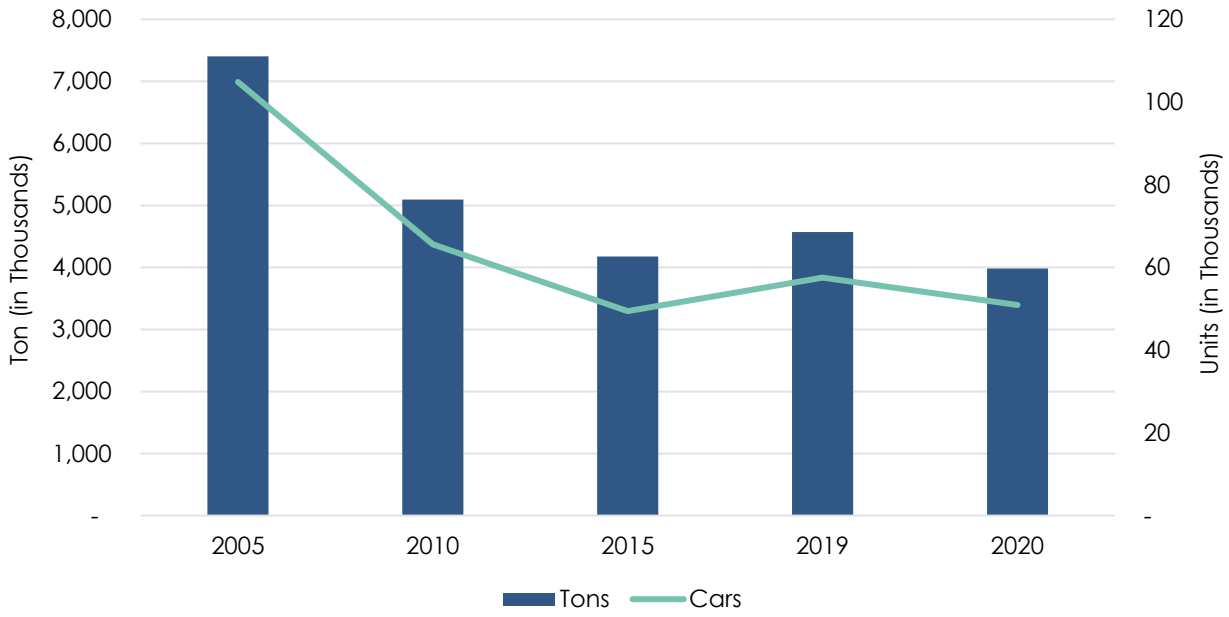


Source: FAF5.2, 2017

The overall statewide rail traffic volumes expressed in tons and units for the years 2005, 2010, 2015, 2019 and 2020 are shown in Figure 2.4. In 2019, total rail volumes reached approximately 4.5 million tons and 57,000 railcar loads. Reflecting the COVID-19 pandemic, 2020 volumes declined from 2019. Therefore, 2020 is an outlier year, and 2019 is more reflective of typical conditions.

Even without considering 2020, rail traffic volumes have been in decline since 2005, although a small increase in tonnage and units had occurred between 2015 and 2019. In comparison to 2005, tonnage dropped by approximately 38 percent, and units by 45 percent respectively. The greater decline in units versus tonnage reflects continued increases in railcar capacity as well as a shifting product mix. These declines in freight activity are examined further in later sections of this memorandum.

Figure 2.4 Maine Total Tonnage and Units Shipped by Rail, 2005 – 2020



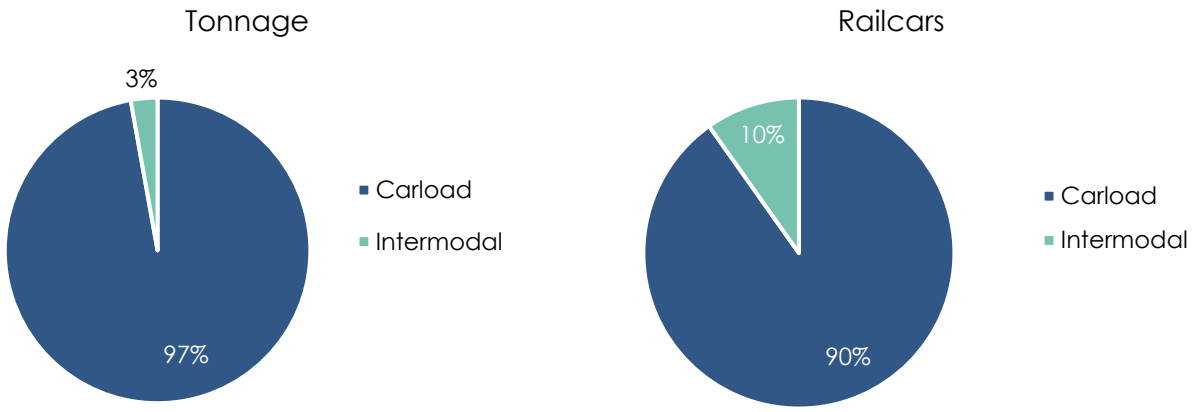
Source: STB Confidential Carload Waybill, 2005, 2010, 2015, 2019 and 2020

To distinguish between carload and intermodal traffic, the type of railcars and corresponding commodities are referenced. The key distinction between carload and intermodal traffic is that the former entails the carriage of freight in a vehicle that is rail-bound. Most commonly, in the present day bulk commodities such as aggregates, chemicals, grain, and coal are handled in this manner. To a lesser degree, manufactured goods, including assembled motor vehicles, machinery, construction materials, paper, etc. are also handled in carload service. Intermodal traffic consists of shipments that can be transported using multiple modes – primarily highway, rail and water - without having to transfer the contents between mode-specific vehicles. Intermodal traffic includes any commodity that can be handled in a dry van or refrigerated trailer, from consumer goods to intermediate manufactured goods and even raw materials.

As shown in Figure 2.5, the vast majority of freight moving by rail is handled in carload service, accounting for 97 percent on a tonnage and 90 percent on a unit basis. The disparity between tonnage and units for carload and intermodal traffic is primarily accounted for by the vastly higher capacity of railcars, which is approximately 3-5 times that of intermodal trailers and containers on a volume and tonnage basis. In addition, commodities handled in

intermodal service tend to be of lower density than those typically handled in carload service.

Figure 2.5 Rail Freight Tonnage and Units, Carload and Intermodal Split (2019)



Source: STB Confidential Carload Waybill, 2019.

2.1.3 Traffic by Direction

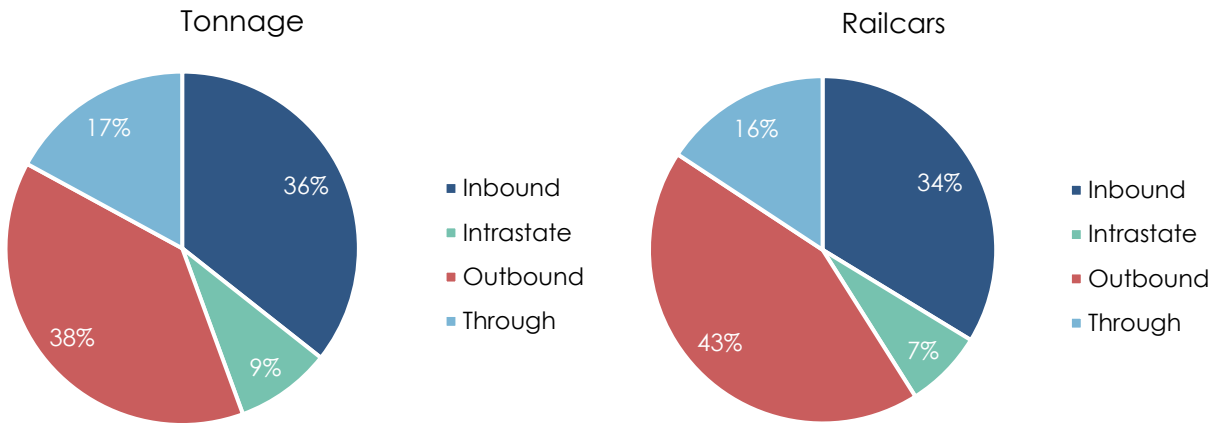
The next data to be examined is the direction of freight traffic handled on Maine's rail system. Directionality of traffic is commonly classified as follows:

- Originating or Outbound: Shipments originating in Maine with a destination outside of Maine
- Terminating or Inbound: Shipments originating outside of Maine with a destination in Maine
- Intrastate: Shipments that have both an origin and a destination within the state of Maine
- Through: Shipments that neither originate nor terminate in Maine. Sometimes referred to as "bridge" traffic, these shipments utilize Maine's rail network to reach their destination, and Maine's geography is unique in that it offers the shortest distance route between some Canadian origins and destinations.

As shown in Figure 2.6, approximately 74 percent of rail freight volumes are associated with shipments either originating or terminating in Maine. Through traffic accounted for roughly one out of six shipments in 2019. Given the location of Maine as the northernmost state within the United States, with only one bordering state (New Hampshire), this through freight consists

of moves within Canada and between the United States and Canada. Volumes in this category can be expected to grow as the result of the 2020 (re)acquisition by CP of its historical trackage across the state, as well as the 2022 acquisition of Pan Am Railways by CSX.

Figure 2.6 Rail Freight Tonnage and Unit Activity Directional Split (2019)



Source: STB Confidential Carload Waybill, 2019.

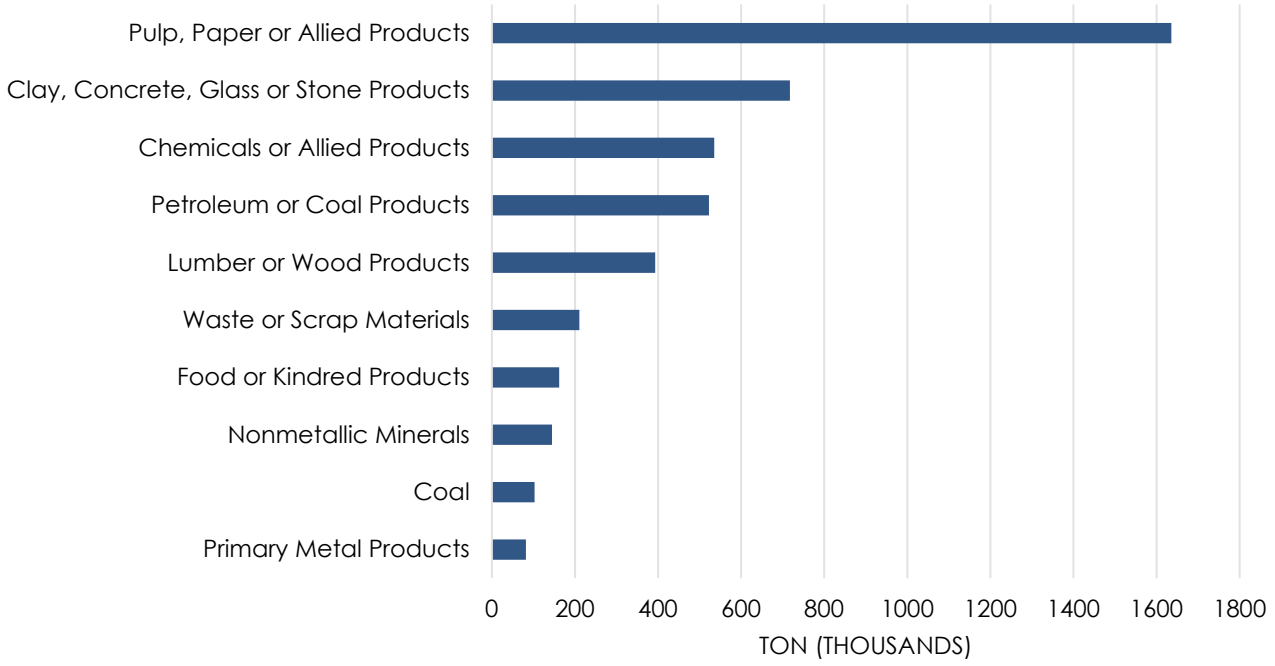
2.1.4 Top Commodities

The top ten commodities on a tonnage basis transported by rail in Maine are shown in Figure 2.7 below. Together these commodities comprise 99 percent of all rail tonnage across the state. More than a third of rail tonnage is comprised of pulp, paper, and allied products. When also factoring in lumber and wood products, total forest products-related tonnage comprises approximately 45 percent. This is expected given the significance of forest products as a freight-intensive industry in Maine, and the economic advantages that carload rail can bring to handling the associated commodities. Additional commodities with over 500 thousand annual tons include aggregates and chemicals.

Coal is typically examined in further detail, as it has historically been the single highest tonnage commodity handled nationally by railroads. Most commonly used for the production of electricity, starting in 2008 utility coal production entered a period of secular decline as utilities began phasing out aging coal-fired power plants in favor of electricity production using natural gas and renewables. This has impacted rail tonnage, particularly in states with coal production and fleets of coal-fired electricity generating stations. This has

never been the case in Maine, where coal has primarily been used for industrial purposes. As of 2019, coal ranked ninth in terms of tonnage at approximately 100 thousand tons, placing it well below other major commodities, including those related to the forest products industry, as well as aggregates and chemicals.

Figure 2.7 Top Rail Freight Commodities by Tonnage (2019)

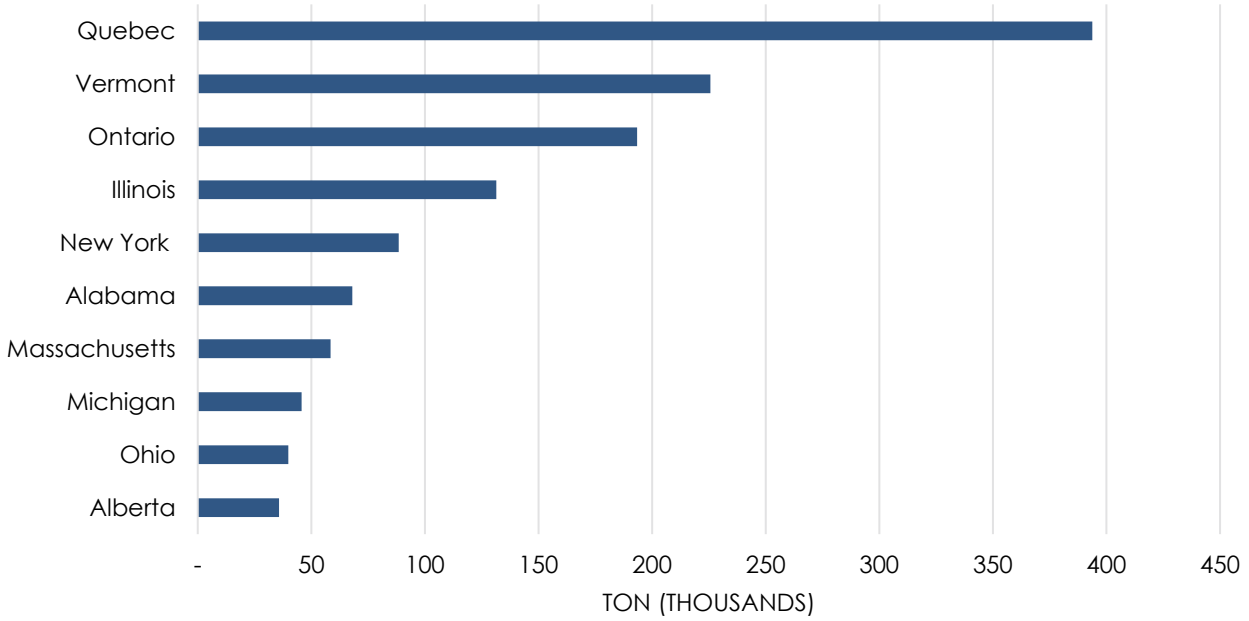


Source: STB Confidential Carload Waybill, 2019.

2.1.5 Trading Partners

Top trading partners are broken out by inbound and outbound rail freight activity in the following figures. The top ten inbound trading partners in 2019, by tonnage, are shown in Figure 2.8. Together, these trading partners account for approximately 78 percent of inbound tonnage. Notably, amongst this group, Canadian provinces Quebec, Ontario, and Alberta accounted for almost half (approximately 46 percent) of the top tonnage. Within the United States, the top trading partners were Vermont, Illinois, and New York. Beyond these states, the remaining top trading partners are largely scattered across the Midwest and South. Overall, top inbound trading partners are relatively dispersed across the eastern United States and select Canadian provinces.

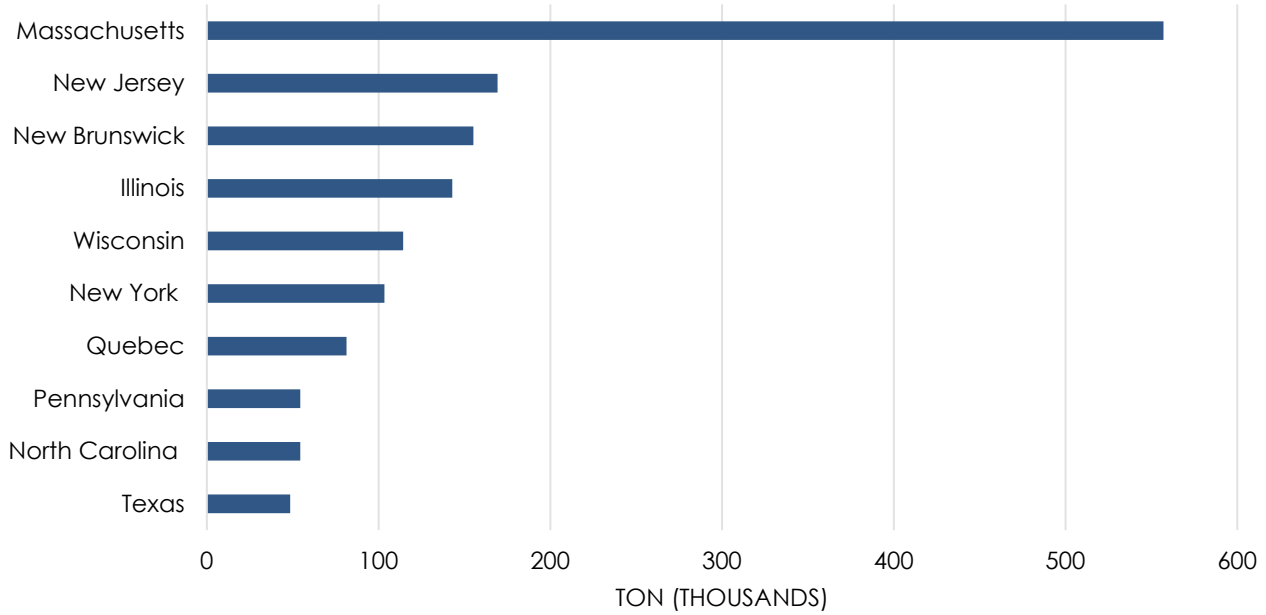
Figure 2.8 Maine Top Inbound Trading Partners for Rail, Tonnage Basis (2019)



Source: . STB Confidential Carload Waybill, 2019.

Outbound trading partners are shown in Figure 2.9. Together, these trading partners account for approximately 85 percent of outbound tonnage. Massachusetts is by far the largest trading partner in terms of outbound tonnage at over 500 thousand tons, followed by New Jersey and the Canadian province of New Brunswick. Outside of these locations, with the exception of Illinois, Wisconsin, and Texas, the other top trading partners are scattered across the eastern seaboard.

Figure 2.9 Maine Top Outbound Trading Partners for Rail, Tonnage Basis (2019)



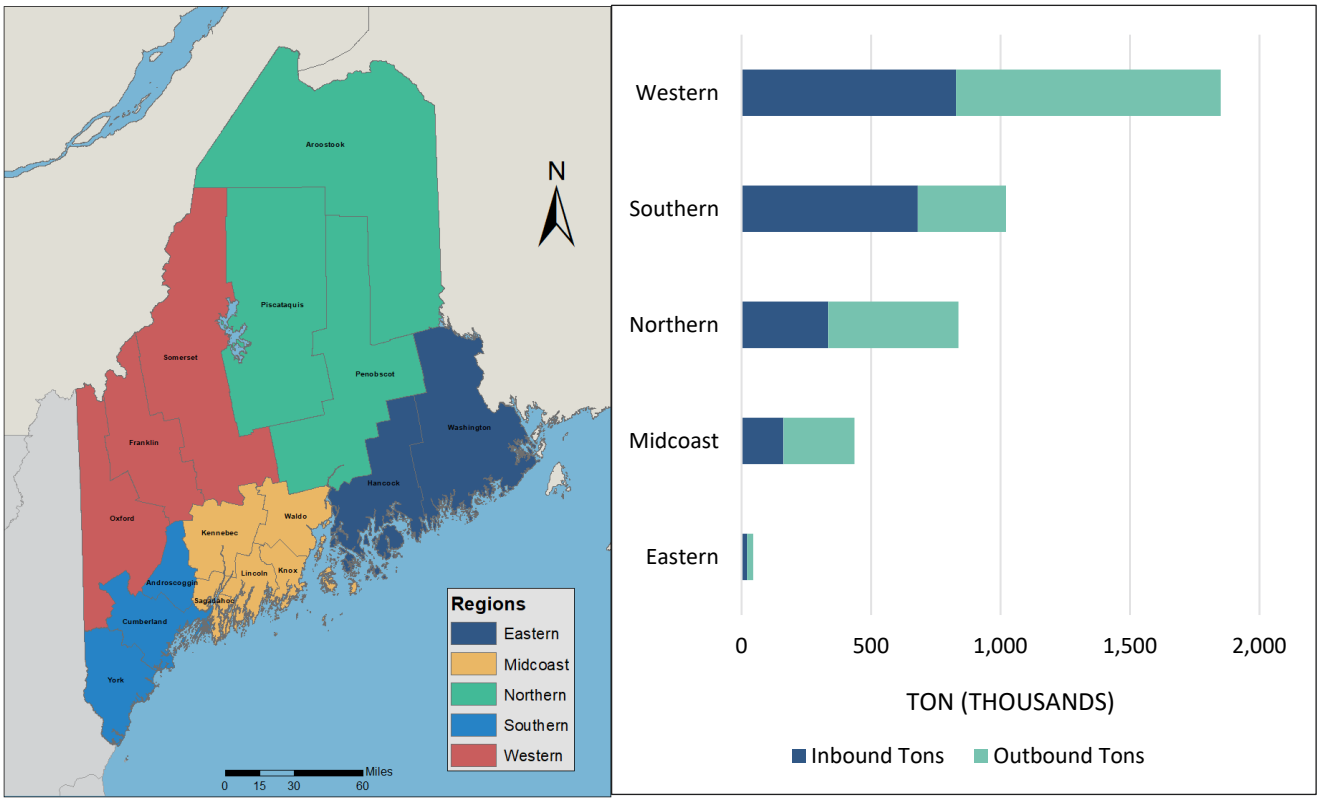
Source: STB Confidential Carload Waybill, 2019.

2.1.6 Freight Generation by Maine Region

Whereas the previous section analyzes the geography of inbound and outbound freight to and from Maine, this section focuses on the distribution of rail freight activity within Maine. This information is first broken out graphically by region[5] in Figure 2.10. Broken out by region, Western Maine records the highest rail freight tonnage, both in terms of inbound and outbound tonnage. The Southern Region, the most populous, in Maine, ranked second in terms of rail tonnage at approximately 1 million tons, a large proportion of this was inbound. Maine's Northern Region had the third highest level of rail tonnage at approximately 800 thousand tons. These results appear to be consistent with overall economic activity across Maine. Although the Western and Northern regions of Maine are more sparsely populated, they are also home to a large portion of Maine's forest products industry. As a result, this economic activity supports both inbound and outbound rail freight traffic.

[5] Regions are defined as:
- Eastern Region include Hancock, Washington.
- Midcoast Region include Kennebec, Knox, Lincoln, Sagadahoc, and Waldo.
- Northern Region include Aroostook, Penobscot, and Piscataquis.
- Southern Region include Androscoggin, Cumberland, and York.
- Western Region include Franklin, Oxford, and Somerset.

Figure 2.10 Rail Freight Tonnage by Maine Region (2019)



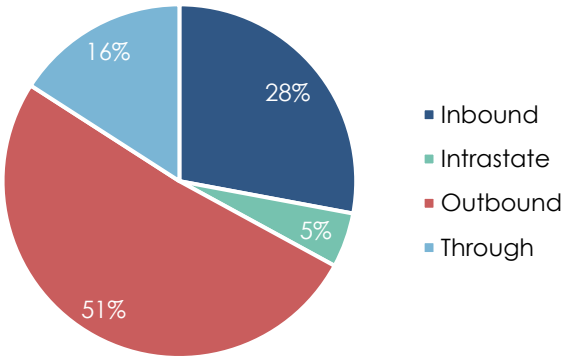
Source: STB Confidential Carload Waybill, 2019.

2.1.7 Value of Freight

In 2019, there were 4.5 million tons of freight moving in Maine's rail system, these commodity flows are valued at $4.4 billion. Figure 2.11 shows the directional split of the total rail shipments' value in 2019. It shows that outbound traffic accounted for over half of rail volume on the basis of commodity value shipped. This is followed by inbound traffic, which accounts for 28 percent of value. Consistent with trends in most states, intrastate traffic represents a dwindling share of traffic, accounting for only 5 percent.

A breakdown of commodity value shipped by rail on a 2-digit STCC basis is shown in Table 2.1 and Figure 2.12 below. Pulp, paper and allied products accounted for almost 60 percent of the value of goods shipped by rail. Chemicals accounted for a further 20 percent of rail traffic, with the remaining 20 percent consisting of a broad range of commodities. This mix can be expected to change significantly as CP grows traffic on its route across Maine that links New Brunswick with Quebec and the western provinces.

Figure 2.11 Value of Rail Shipments by Direction (2019)



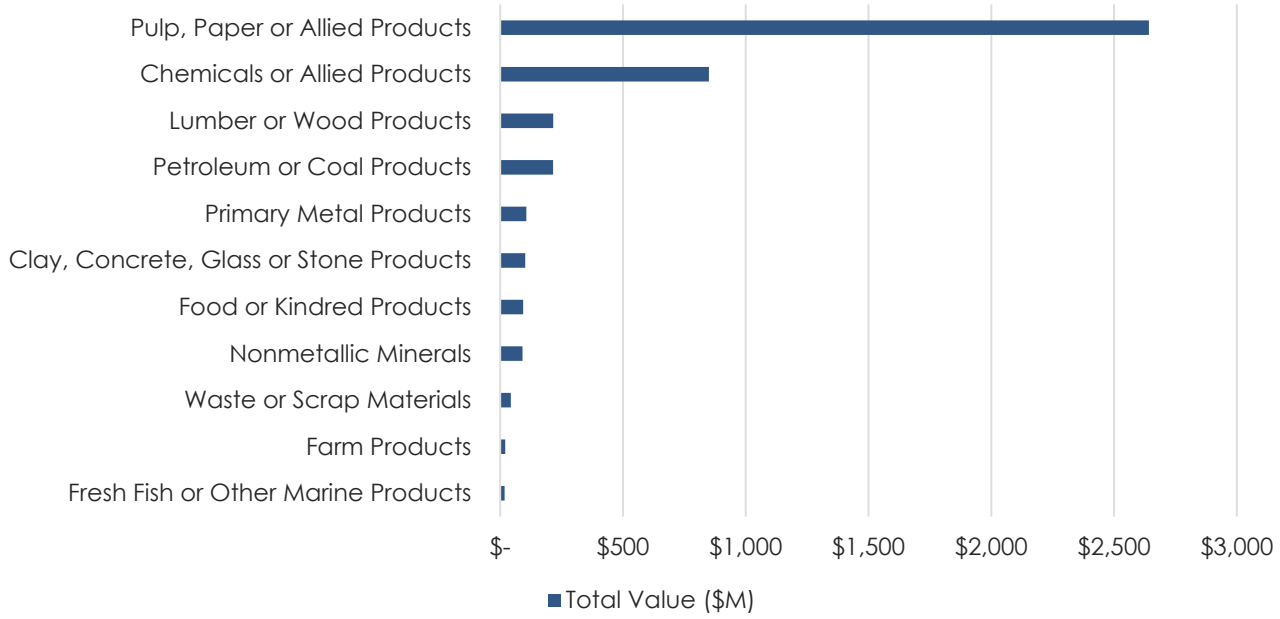
Source: Tons from STB Confidential Carload Waybill, 2019 with commodity $ value per ton from S&P Global.

Table 2.1 Top Rail Commodities by Tonnage and Value (2019)

STCC2	Commodity	Tons	Value ($ Millions)
26	Pulp, Paper or Allied Products	1,635,760	$2,641.73
32	Clay, Concrete, Glass or Stone Products	717,240	$102.16
28	Chemicals or Allied Products	535,368	$849.87
29	Petroleum or Coal Products	522,600	$215.51
24	Lumber or Wood Products	393,240	$216.44
40	Waste or Scrap Materials	210,520	$43.19
20	Food or Kindred Products	161,908	$93.54
14	Nonmetallic Minerals	144,600	$90.72
11	Coal	102,648	$3.28
33	Primary Metal Products	82,052	$106.63
1	Farm Products	58,896	$20.80
48	Hazardous Wastes	3,880	$0.35
37	Transportation Equipment	2,120	$2.11
9	Fresh Fish or Other Marine Products	1,440	$18.24
30	Rubber or Miscellaneous Plastics Products	280	$1.16
Total		**4,572,552**	**$4,405.73**

Source: STB Confidential Carload Waybill, 2019, and commodity $ value per ton from S&P Global.

Figure 2.12 Top Rail Commodities Ranked by Value (2019)



Source: STB Confidential Carload Waybill, 2019, and commodity $ value per ton from S&P Global.

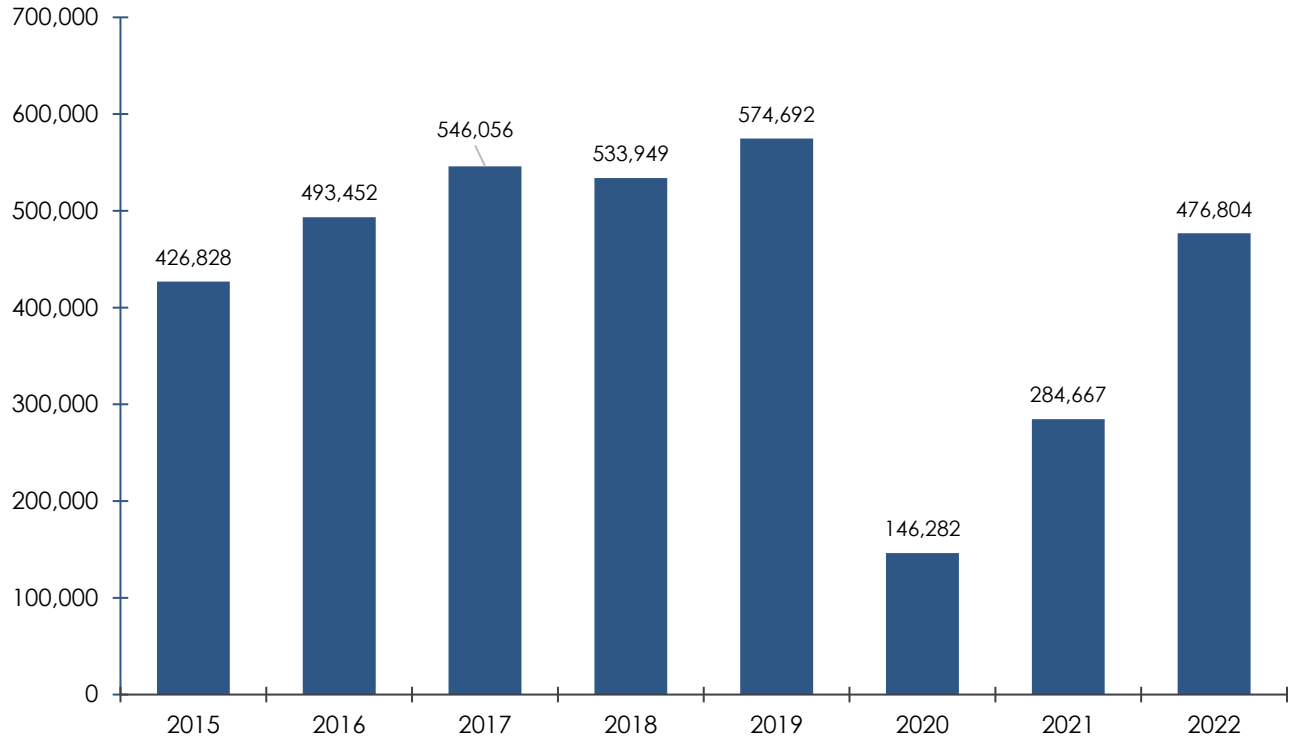
2.2 Passenger Rail Profile

This section provides an overview of the state's passenger rail system's performance, including ridership, on-time performance, financial performance, and a discussion of delays on the *Downeaster*.

2.2.1 Ridership

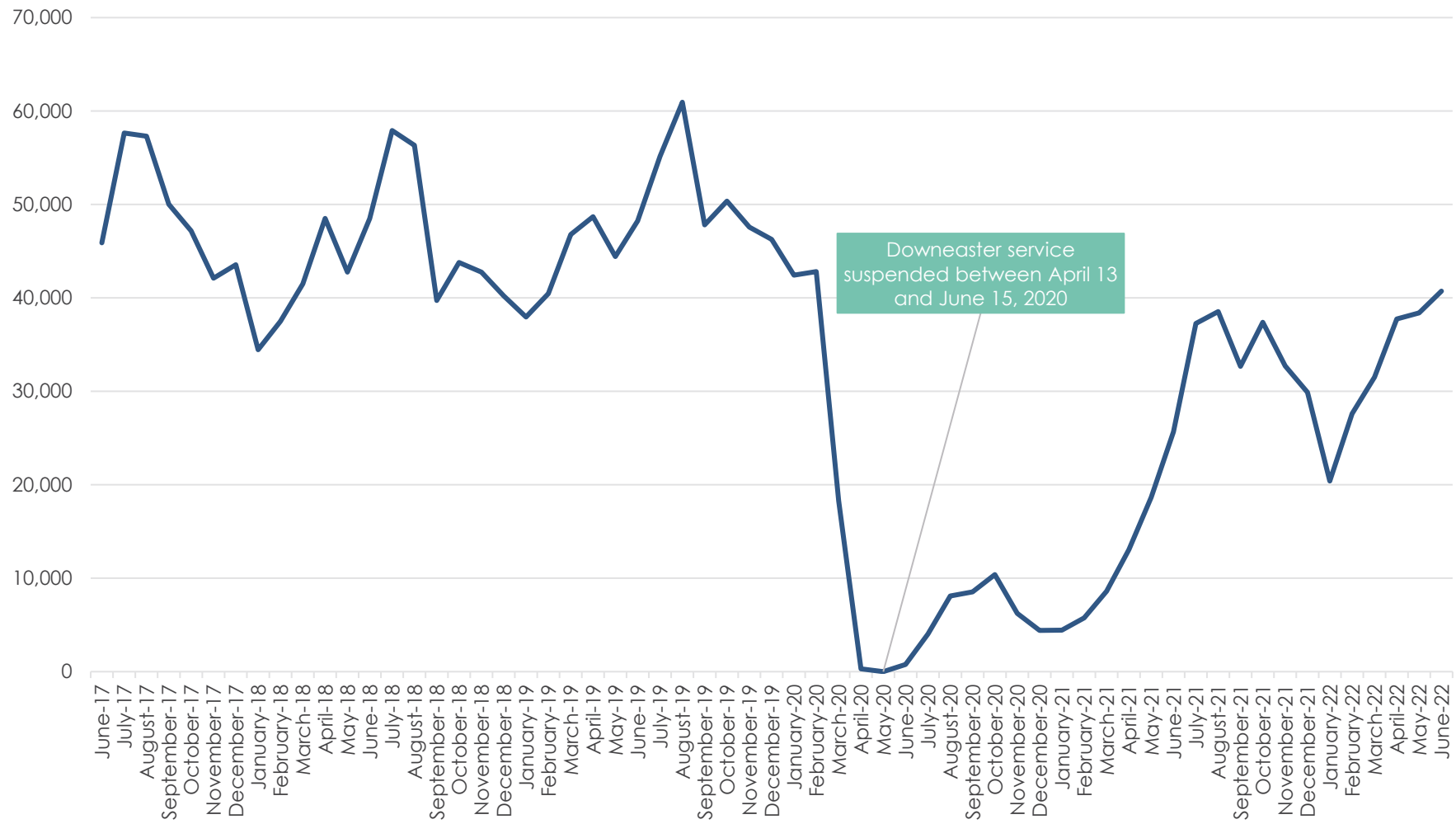
Between 2015 and 2019, the Downeaster's annual passenger ridership continued to steadily increase, excepting a slight drop in 2018 associated with construction-related service outages (see Figure 2.13). Overall, during this period ridership increased by nearly 35 percent, reaching a high of almost 575,000 annual passengers in 2019. Due to the impacts of COVID-19, which resulted in temporary suspensions and frequency reductions, ridership dipped sharply in 2020 and 2021. However, as Figure 2.14 shows, on a month-by-month basis ridership began a strong recovery in the spring of 2021, exceeding 50,000 passengers in August 2022. Subsequently, ridership has continued to recover, with some setbacks during periods of high COVID-19 infection rates.

Figure 2.13 Downeaster Annual Ridership, Calendar Year 2015-2022



Source: NNEPRA, 2022.

Figure 2.14 Monthly Downeaster Ridership, 2017-2022

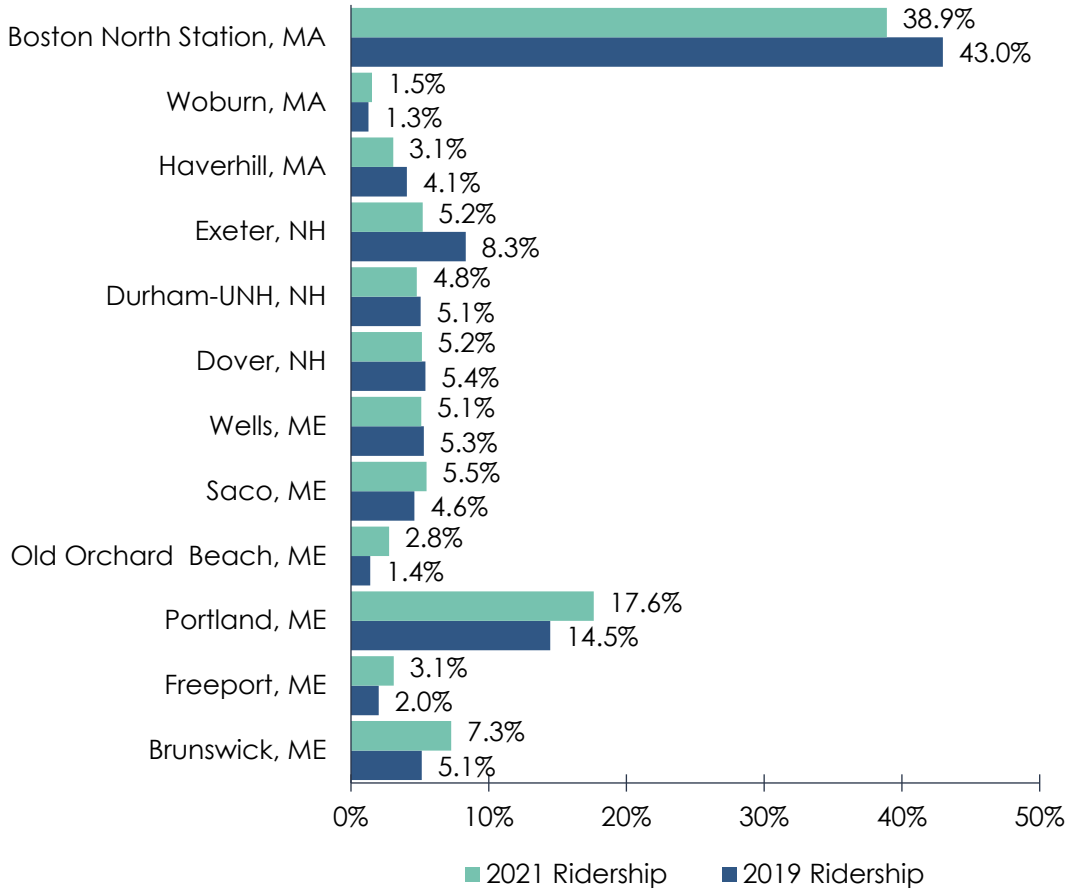


Source: NNEPRA, 2022.

Origins and Destinations of Downeaster Riders

Figure 2.15 shows the contributions of each station to Downeaster ridership in 2019 and 2021, providing some early indications of travel patterns as they have been affected by the pandemic. Most riders use Boston North Station as their origin or destination station, comprising nearly 40 percent of ridership. The next highest-used station is Portland Transportation Center. Since the resumption of service in June 2020, the proportion of riders originating or alighting at stations in Maine increased modestly; this has come largely due to the decrease in commuters traveling to/from stations in Massachusetts and New Hampshire (Exeter, Durham and Dover) associated with the post-pandemic shift to hybrid work options.

Figure 2.15 Percentage of Total Downeaster Ridership by Station (CY 2019 vs. CY 2021)

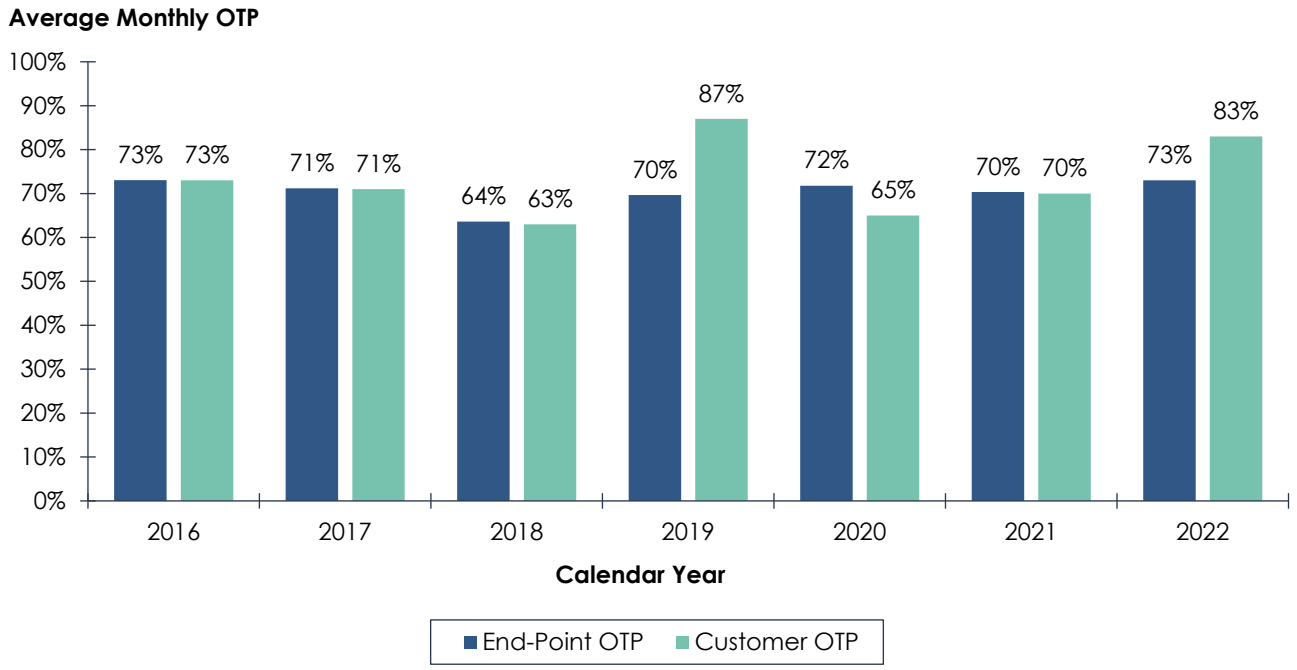


Source: NNEPRA

2.2.2 On-time Performance

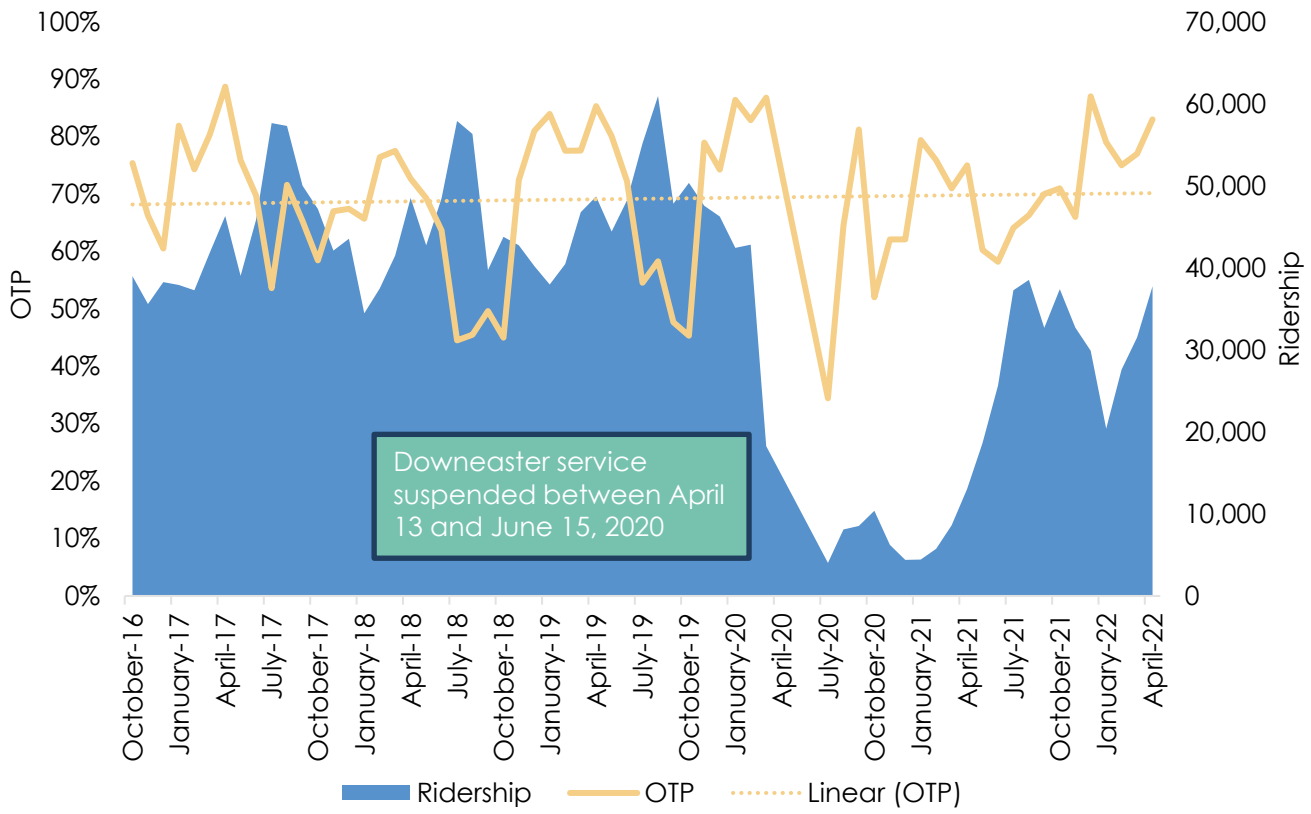
On-time performance (OTP) is a critical measure of the efficacy of passenger service, with direct impacts on operating costs, passenger satisfaction, and likelihood of future use. NNEPRA uses "end-point OTP" (OTP) and "customer OTP" (COTP) to measure performance. OTP is calculated by taking the total number of trains arriving "on-time" at the end-point of the run divided by the total number of trains operated on the run, COTP reflects the percentage of passengers who arrived at their endpoint destination within 10 minutes of scheduled travel time. OTP on the *Downeaster* has stayed relatively stable over the past five years, mostly hovering around 70 percent on an average annual basis between 2016 and 2022, as can be seen in Figure 2.17. After dipping to 64 percent in 2018, OTP recovered to 70 percent in 2019 and has stayed closed to that level throughout the COVID-19 pandemic, aside from some fluctuations when service was disrupted at the beginning of the pandemic, as shown in Figure 2.18. Customer OTP reached a high of 87 percent in 2019, before declining during the COVID-19 pandemic. In 2022 (YTD), COTP has rebounded to 83 percent.

Figure 2.16 Downeaster Average On-Time Performance (2016 -2022)



Source: NNEPRA, 2022

Figure 2.17 Ridership and OTP, 2016 - 2022



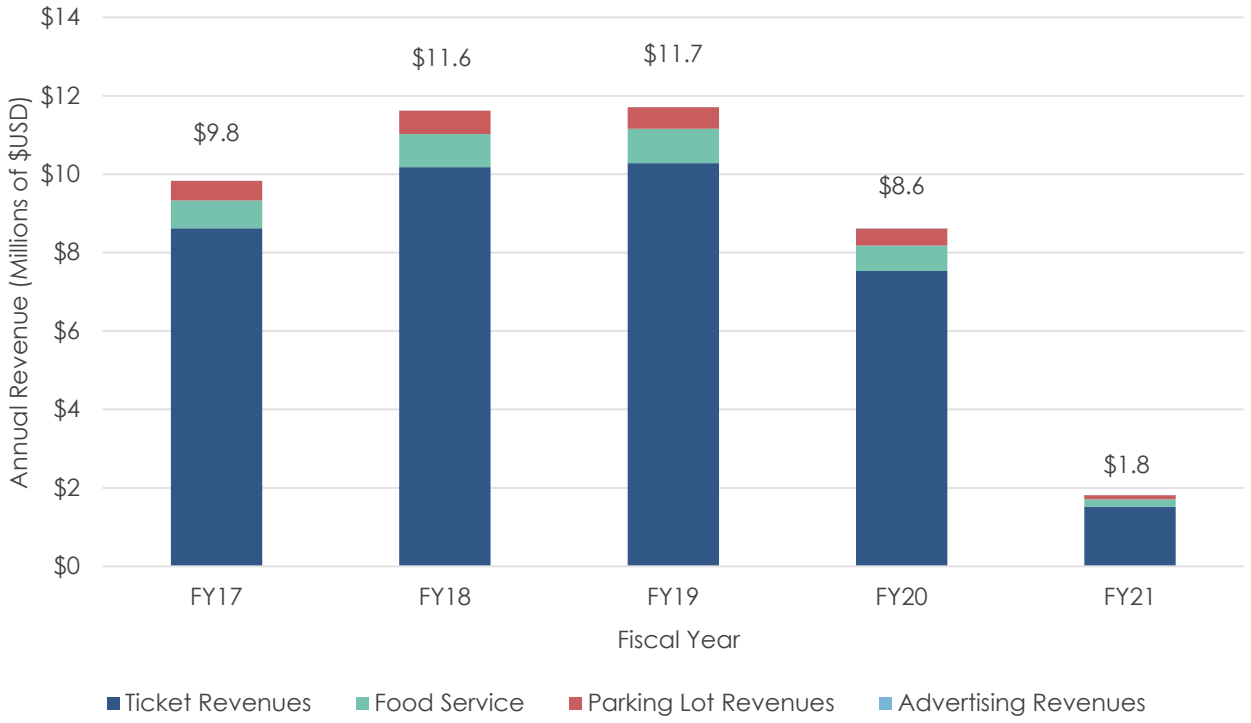
Source: NNEPRA, 2022

2.2.3 Financial Performance

Between 2016 and 2019, the Downeaster generated an increasing amount of revenue, reaching nearly $11.7 million in revenue in FY2019, representing a 20 percent increase. Due to the impacts of the COVID-19 pandemic (detailed above), revenues dropped in FY20 and FY21, falling to only $1.8 million in annual operating revenue in the last fiscal year, as shown in Figure 2.19.

Ticket revenues generally make up the vast majority of all Downeaster revenue, followed by food service and parking revenues. Between FY17 and FY20, the percentage of revenue accounted for by tickets remained nearly constant at 87.4-87.7 percent. However, in FY21, this share declined to 83.7 percent of revenues, while food service climbed from 7.5 percent to 10.3 percent and parking revenues rose from 5 to 6 percent between FY20 and FY21.

Figure 2.18 Downeaster Revenue, FY 2017 – FY 2021



Source: NNEPRA, 2022

Below Table 2.2 shows the major sources of operating expenses for the *Downeaster* over the last five fiscal years. Railroad operating expenses ("commuter railroad") typically make up around 85 percent of all expenses, although these expenses declined by over $5 million between FY2020 and FY2021 due to a decline in passenger train service following the onset of the COVID 19 pandemic in March 2020.

Table 2.2 Downeaster Operating Expenses, FY 2017 - FY 2021 (thousands of $)

Operating Expenses	FY2017	FY2018	FY2019	FY2020	FY2021
Commuter Railroad	$18,034	$19,151	$19,603	$16,683	$11,603
Wage and Fringe Benefits	$586	$560	$586	$856	$888
Marketing	$520	$492	$517	$436	$271
Station Operations	$567	$555	$556	$297	$493
Food Service	$915	$965	$1,005	$814	$552
Other	$535	$611	$619	$820	$1,065
Total	**$21,156**	**$22,334**	**$22,886**	**$19,907**	**$14,871**

Source: NNEPRA, 2022

2.2.4 Causes of Delay

Delays for Amtrak routes can be separated into three categories: (1) issues caused by host railroads, (2) issues caused by Amtrak, and (3) issues caused by trespassers. These categories assist in the analysis of OTP of Amtrak service, which is often affected by these kinds of problems. The top 10 delay causes in 2021 are shown below in Table 2.2, with the delay minutes in 2019 shown for comparison. Speed restrictions, communication and signal issues, and train interference are the primary catalysts of *Downeaster* delays. Due to significant single-track sections of the route's right-of-way in Maine and New Hampshire, even minor disruptions result in passenger train interference and cascading delays throughout the day.

Table 2.3 Top 10 Causes of Delay to Downeaster, CY 2021 vs. CY 2019

Delay Code	Responsibility	Explanation	Delay Minutes (2019)	Delay Minutes (2021)
PTI	Host	Passenger Train Interference	6,800 (19%)	6,612 (19%)
DSR	Host	Speed restriction due to defect, slow orders	5,829 (17%)	5,465 (16%)
DCS	Host	Signal failure or other signal delays	4,658 (13%)	5,072 (14%)
FTI	Host	Freight Train Interference	3,591(10%)	4,277 (12%)
CTI	Host	Commuter Train Interference	3,053 (9%)	2,779 (8%)
ITI	Amtrak	Delay at initial terminal due to late arriving inbound trains	2,572 (7%)	2,532 (7%)
SYS	Amtrak	Delays related to crews including lateness, lone-engineer delays	164 (0.5%)	1,741 (5%)
DMW	Host	Maintenance of Way Delays	2,130 (6%)	1,513 (4%)
NOD	Third Party	Unused Recovery Time	123 (0.3%)	1,028 (3%)
TRS	Third Party	Trespassers	1,035 (3%)	847 (2%)

Source: NNEPRA, 2022

3. ECONOMIC PROFILE

Rail traffic, both in the form of passenger and freight movement, is driven in large part by economic conditions. These economic conditions that influence rail traffic stem from multiple sources. Factors such as total population, age composition, employment, and spending power drive demand for travel and goods to varying degrees. At the production level, key freight intensive industries ranging from forestry to chemicals generate additional rail traffic, driven by internal, state, national, and even international economic conditions. This section examines Maine's economy as it relates to the statewide rail network and its corresponding needs.

3.1 Demographic and Economic Trends

The movement of both people and goods alike, across all modes of transportation, is driven in large part by three interconnected factors: overall population, employment and associated economic activity, and spending power (income). The ability to quantify, measure, and analyze these metrics is a necessary step in understanding rail traffic and the transport of people and goods. To assemble the demographic and economic trends, the Rail System Use and Economic Profile utilizes historical Maine state and county economic data assembled by S&P Global from 1990 through 2021, along with projections through 2050.

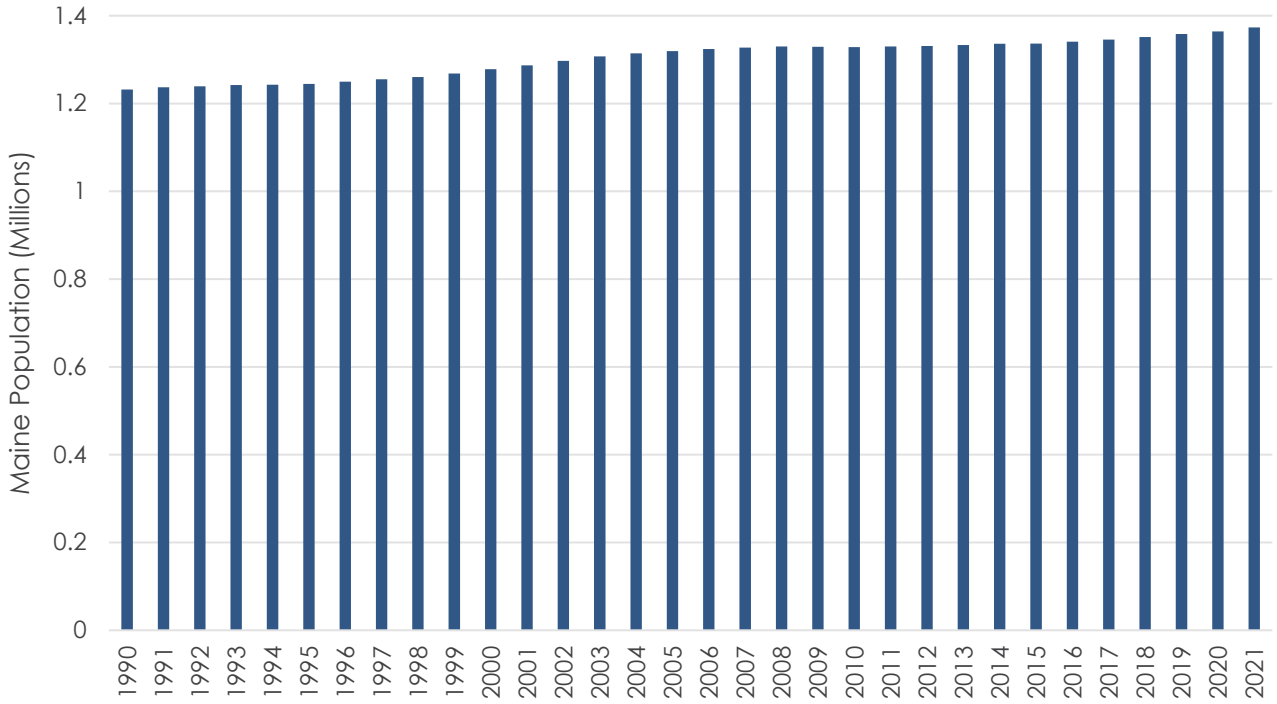
3.1.1 Population

Population is the most fundamental and important driver of economic activity, and correspondingly, demand for the movement of goods and passenger transportation. Overall, a growing population will generate increased demand for goods and services. This demand includes a wide range of components, including increased needs for social services and transportation to those locations, increased demand for food and other consumer products, and growth in demand for construction materials to accommodate new housing and business construction. This includes potential growth in demand for intercity passenger rail service, as well as increased demand for many of the upstream, midstream, and downstream commodities transported by freight rail.

Beginning with overall statewide population, Figure 3.1 below indicates steady growth in Maine since 1990. Through 2021, Maine has added approximately 140,000 residents, and

currently has a population of approximately 1.37 million residents. This makes Maine the 43rd most populous state in the United States.

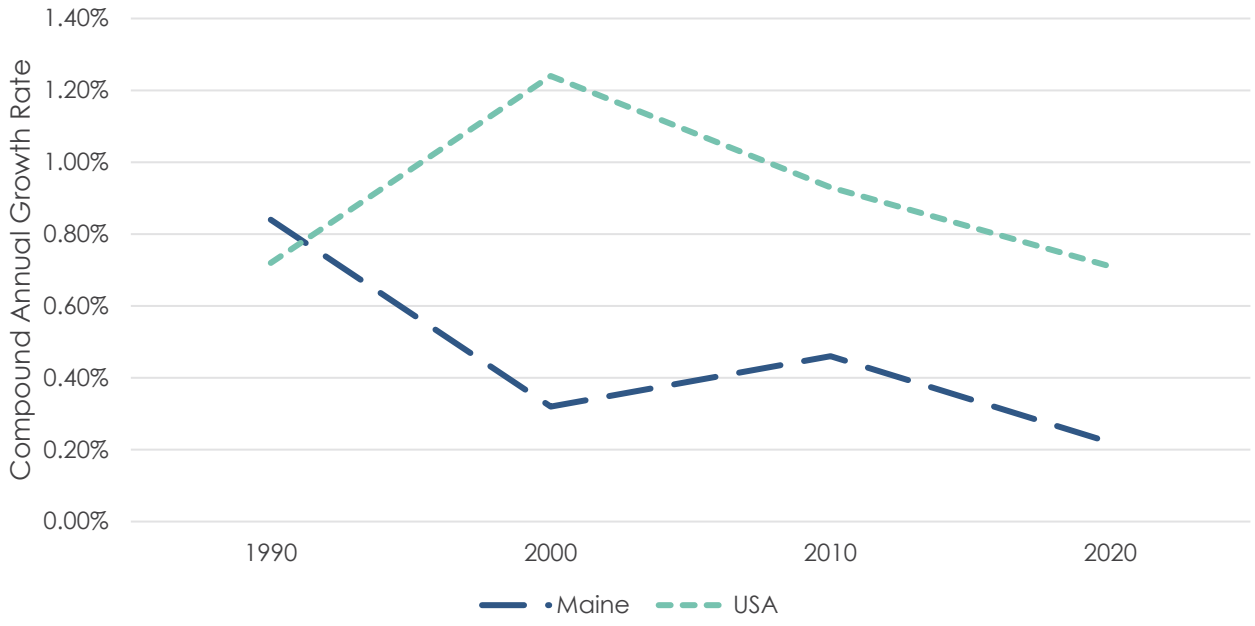
Figure 3.1 Maine Population, 1990 – 2021



Source: S&P Global (2022)

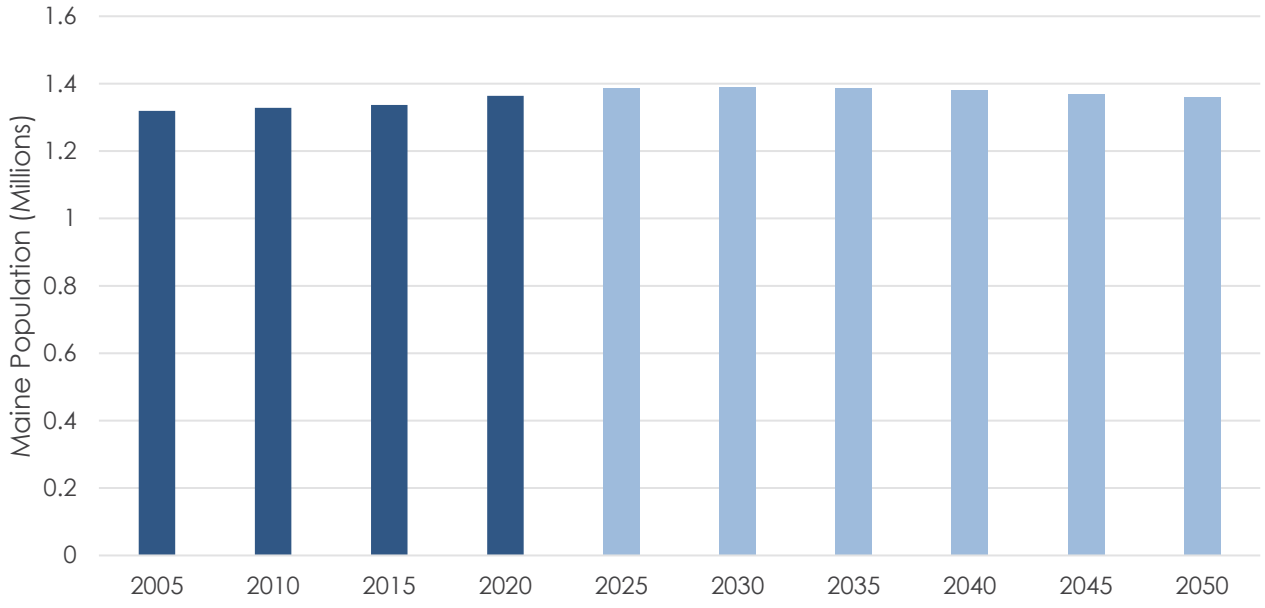
Although Maine's population has risen since 1990, it has grown at a slower rate in comparison to that of the United States as a whole (Figure 3.2), a shift from a higher growth rate leading up to 1990. Between 1990 and 2000, a period of increased population growth rates, the United States recorded a compound annual growth rate of 1.2 percent, compared to just over 0.3 percent for Maine. Additionally, since 2010, growth rates appear to be declining both at the statewide and national level. As Figure 3.3 shows, Maine's population is projected to hover just below 1.4 million residents by 2030 and begin declining slightly beyond 2030. Maine's population is expected to drop back to current population levels (1.36 million residents) by 2050.

Figure 3.2 Maine vs. US Population Compound Annual Growth, 1990 – 2020 (10-Year Periods)



Source: S&P Global (2022)

Figure 3.3 Maine Projected Population, 2025 – 2050



Source: S&P Global (2022)

As shown in Figure 3.4 however, these declines in population are not expected to be uniformly distributed across the state. Large portions of Maine are expected to experience population declines, with growth concentrated in the more urbanized southern portion of the state. York and Cumberland Counties, which include Portland and suburban coastal communities along the Interstate 95 corridor, are expected to grow by 6 percent and 9 percent respectively. This growth can be attributed to multiple factors. These include the growth of Portland itself as a statewide economic center, and relative proximity to major urban centers such as Portsmouth and Boston, as well as additional markets to the south and west.

Population and economic trends in Boston, the largest metropolitan center within close proximity to Maine, appear to be significant drivers of these observations. Like other urban centers, the Boston Metropolitan Region faced multiple challenges in the wake of the Covid-19 pandemic in 2020. However, a combination of an extremely strong real estate market, rising wages, employment growth, and the rise of telecommuting and remote work have resulted in economic impacts well outside of the Boston area. Between 2020 and 2022, the median selling price for a single family house in the Boston Metropolitan Region increased by over 11 percent to nearly $850,000.[6] By comparison, the median home price in Portland for August 2022 was just over $500,000.[7] At the same time, wages in Boston have risen at an elevated pace compared to the rest of the U.S., while employment has grown in well-paying sectors such as life sciences and technology.[8] Combined with increased telecommuting, the additional growth in housing value, wages, and high-skilled employment have spurred increased demand for real estate, including for second "vacation" homes in nearby tourist and naturally appealing areas. This makes regions such as southern Maine, which are comparatively cheaper while also home to quintessential "New England-style" landscapes and beaches, appealing for those in search of second homes where both telecommuting and reasonable proximity to physical offices are possible.

The COVID-19 pandemic appears to have impacted Maine's population favorably, as some families that could work remotely relocated from major East Coast metros to smaller cities and rural regions, often proximate to natural attractions. Whether these new residents

[6] https://www.noradarealestate.com/blog/boston-real-estate-market/

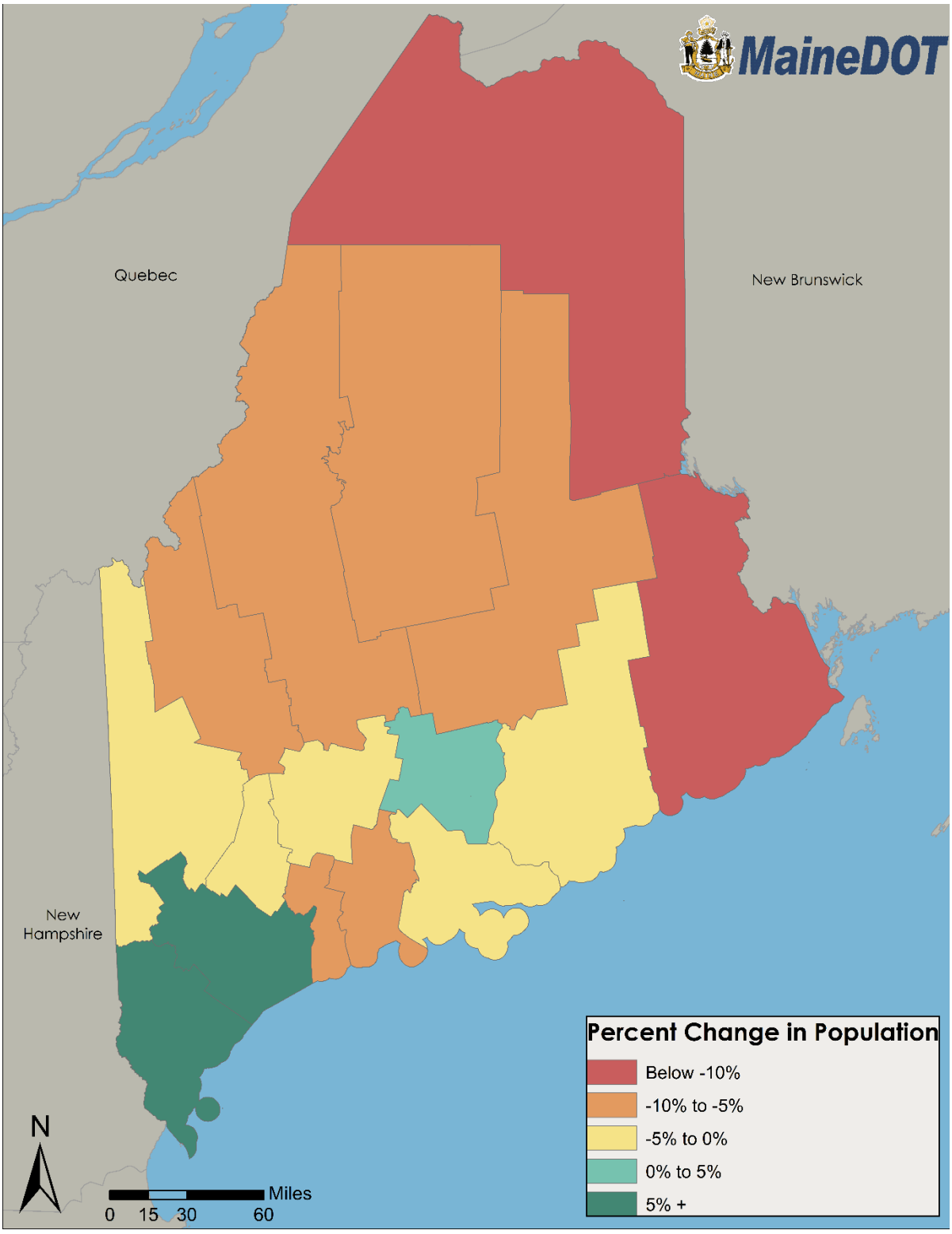
[7] https://www.redfin.com/city/15614/ME/Portland/housing-market

[8] http://www.bostonplans.org/getattachment/b7be231d-c72c-4f87-9c21-e84dcf26c361

remain permanently in these locations will depend on a variety of factors, including the degree to which remote as opposed to in-person work is broadly accepted.[9] Should these trends continue, areas such as southern and coastal Maine could continue to see population and economic growth, a trend reflected in these figures.

[9] https://www.nhbr.com/2022-real-estate-market-outlook-for-northern-new-england/

Figure 3.4 Maine Population Growth by County, 2019 – 2050



Source: S&P Global (2022)

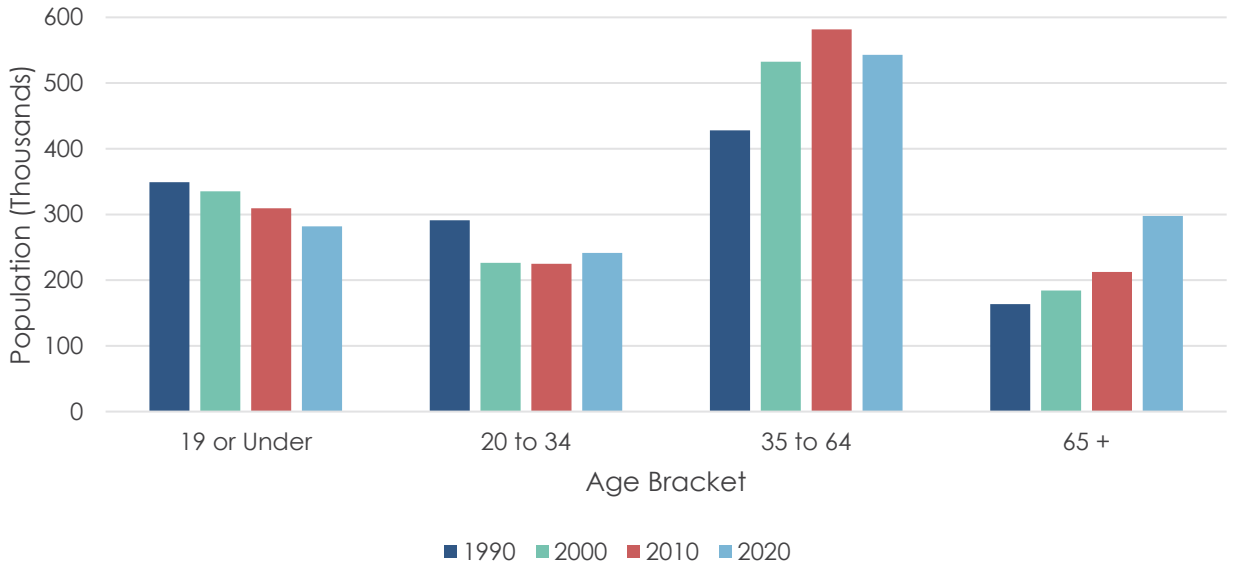
On the other hand, population increases in southern Maine are not expected to offset overall projected declines in the state's total population. This is especially the case given expected declines in the state's inland and rural counties, such as Aroostook, Piscataquis, and Somerset. These declines in rural population are attributed to multiple factors, which include a stagnant or declining job market, aging populations, and additional challenges stemming from isolation from population and economic centers.

From a demographic perspective, the expected declines in population are also reflected in the statewide composition of residents by age bracket. As shown in Figure 3.5, between 1990 and 2020, a period of population growth, Maine experienced a decline in residents under the age of 35. However, this particular decline was offset by an increase in the total population over the age of 35. Despite the population gains through 2020, the 35 – 64 age bracket also experienced a decline in population beginning in 2010. In fact, between 2010 and 2020, the only age bracket to experience population growth was that of 65 and over.

Through 2050 (Figure 3.6), evidence of overall expected population declines are further reflected in drops in the population under the age of 35. At the same time, the 35 – 64 age bracket, previously a growth group, is largely expected to be stagnant. As a result, growth is expected only in the population of 65 and older residents. In fact, from 1990 to 2050, the population of 65 and older is expected to more than double to nearly 400,000. At the same time, the population of residents 19 and younger is expected to drop from approximately 350,000 to under 250,000 by 2050.

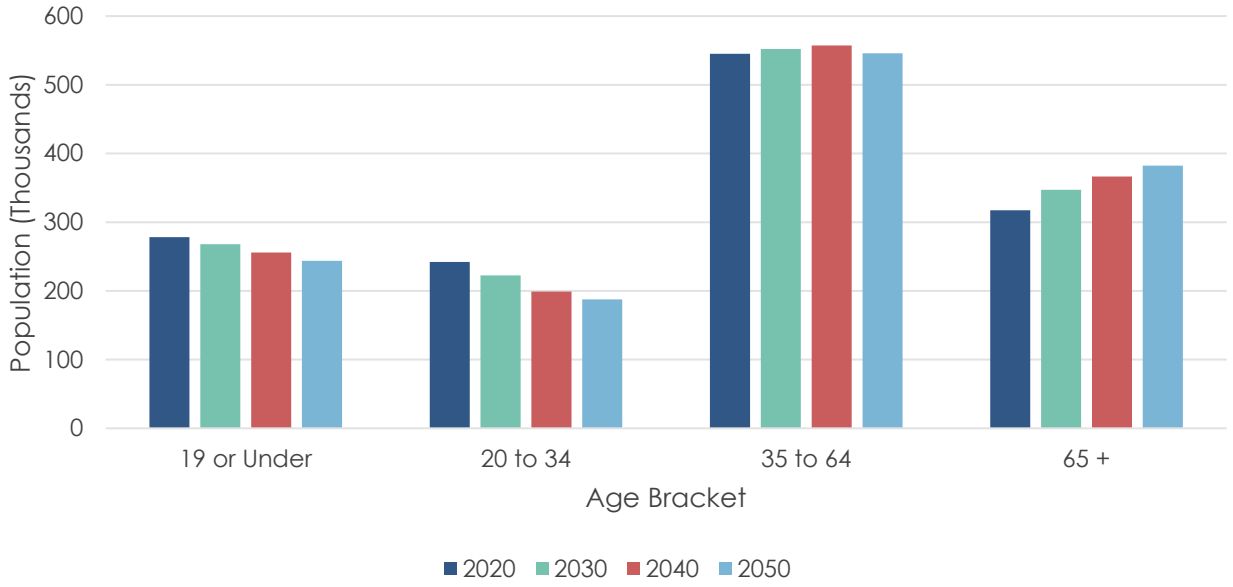
Overall, the population projection indicates a stagnant-to-slightly declining population through 2050. At the regional level, anticipated population growth in the more developed southern portion of Maine will be offset by declines in rural and inland regions. These trends are further evidenced through an examination of age brackets, which indicates an increase in older populations offset by a decrease in younger populations.

Figure 3.5 Historic Population by Age in Maine, 1990 – 2020



Source: S&P Global (2022)

Figure 3.6 Historic and Forecast Population by Age Group in Maine, 2020 – 2050

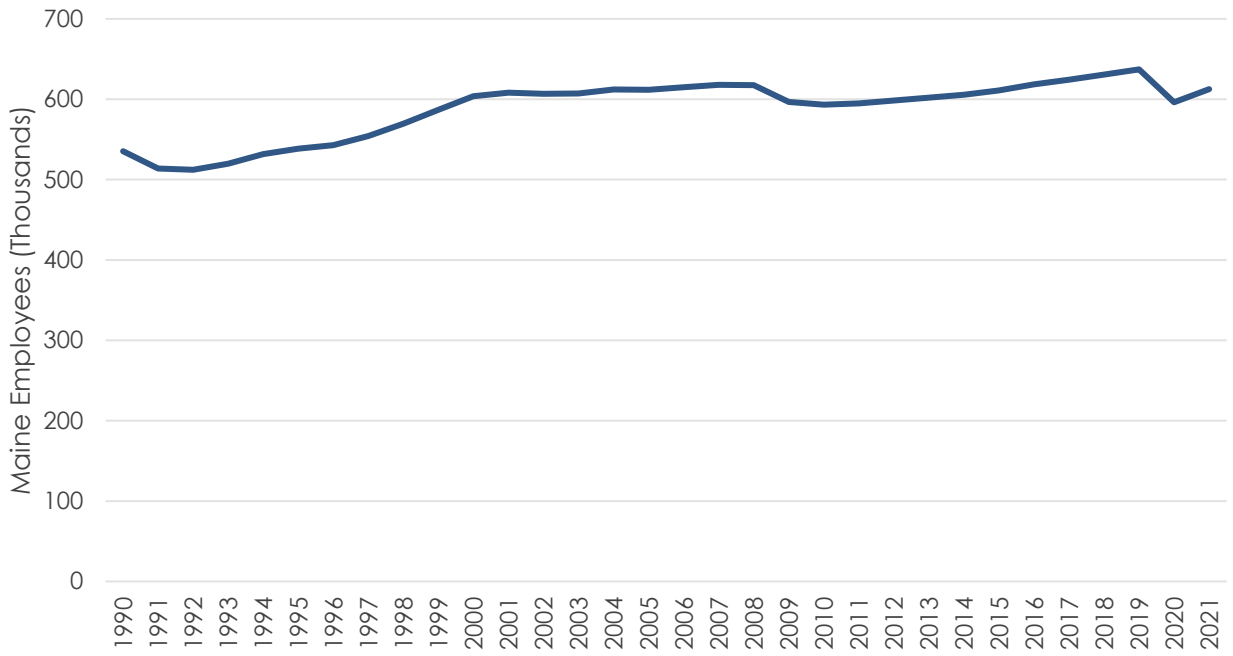


Source: S&P Global (2022)

3.1.2 Employment & Industrial Outlook

As a driver of both population growth and income, employment is a strong indicator of demand for goods movement across all modes, including rail. As shown in Figure 3.7, between 1990 and 2021, total nonfarm employment in Maine has risen steadily. In 2019, total employment reached a high of approximately 637,000, before falling slightly in 2020 as result of the COVID-19 pandemic. In 2021, there were approximately 612,000 nonfarm employees across Maine.

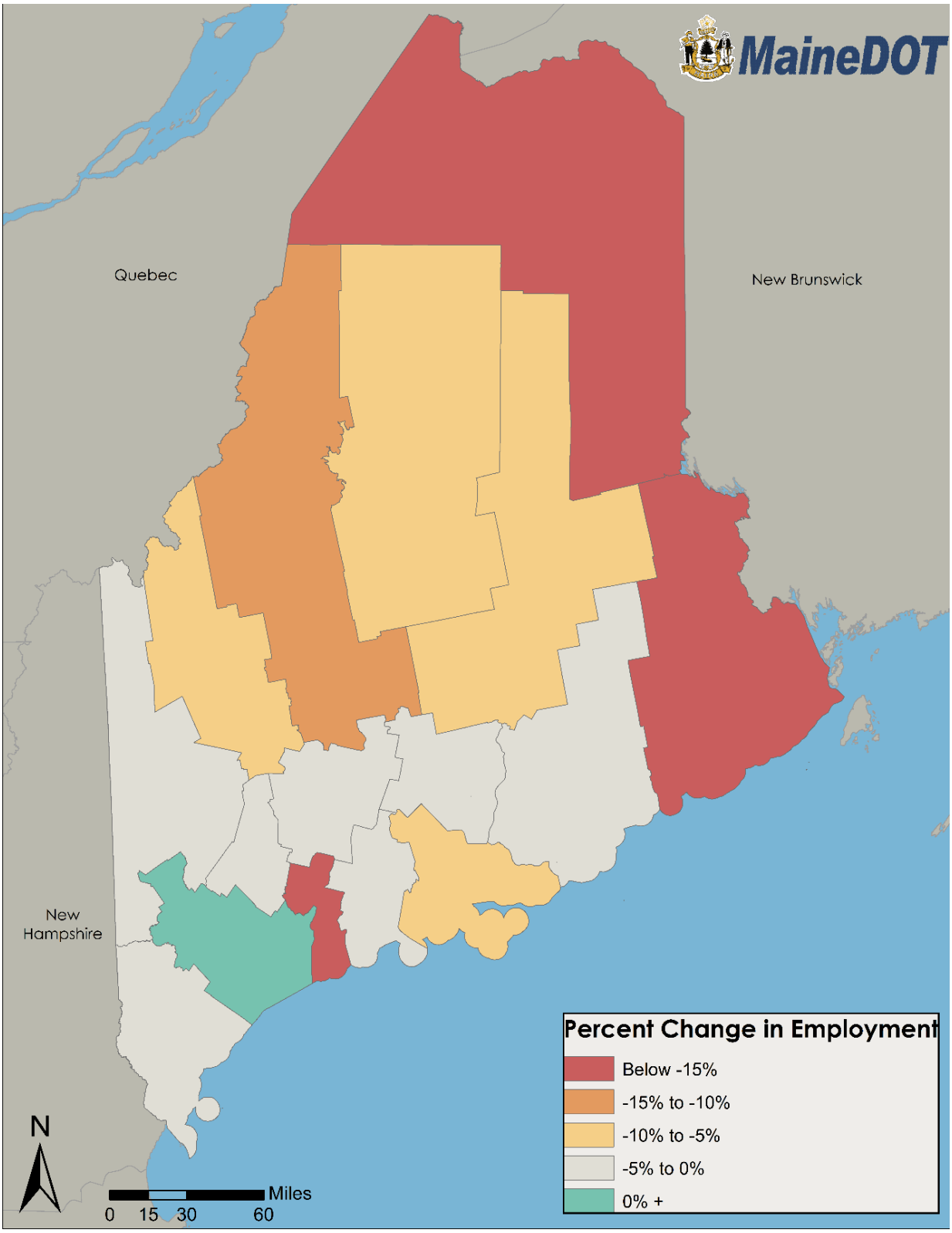
Figure 3.7 Total Number of Nonfarm Employees in Maine, 1990 – 2021



Source: S&P Global (2022)

Expected nonfarm employment through 2050 is shown in Figure 3.8. Through 2050, total nonfarm employment is expected to decrease across all but one county in Maine. Mirroring expected changes in population (Figure 3.4), most of the largest declines in total nonfarm employment are expected in rural and inland portions of the state. On the other hand, employment in Cumberland County, home to Maine's most urbanized and largest city, Portland, is expected to increase by approximately 9 percent.

Figure 3.8 Maine Employment Growth by County, 2019 – 2050

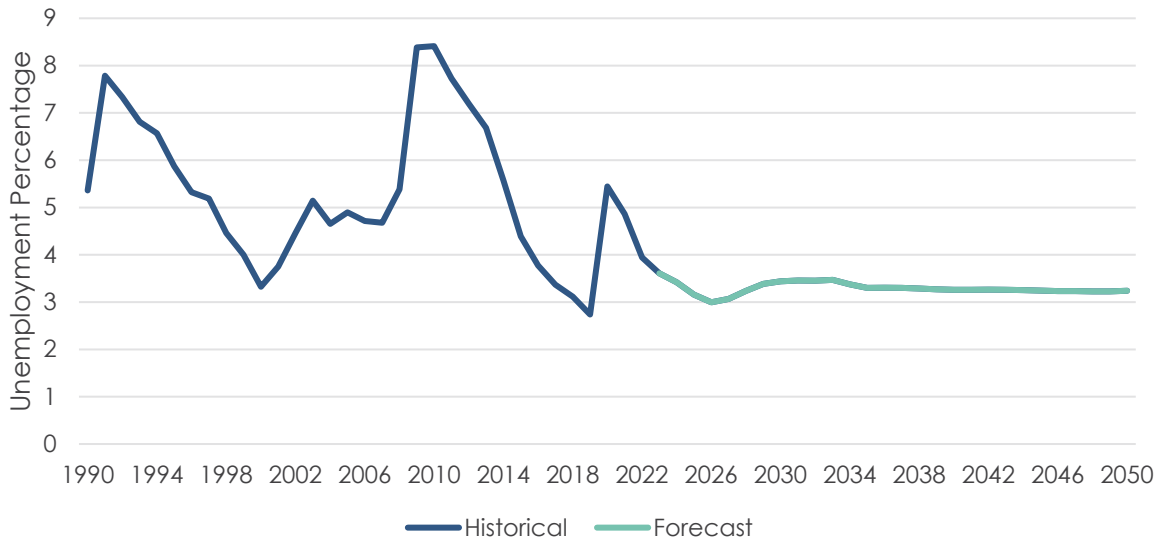


Source: S&P Global (2022)

As an additional indicator of economic health, the statewide unemployment rate of Maine is shown in Figure 3.9. Although total employment has steadily risen, the statewide unemployment rate has experienced significant fluctuations since 1990. Largely in-line with national figures, these fluctuations are primarily the result of macroeconomic trends. During the COVID-19 pandemic the unemployment rate quickly spiked from under 3 percent in 2019 to nearly 5.5 percent in 2020. Since then, the unemployment rate has declined to under 4 percent in 2022. As described above, migrations from urbanized regions to the south, such as Boston, have influenced statewide economic trends. Between April 2020 and May 2021 for example, Maine saw a net increase of more than 1,200 workers from Massachusetts. This is in addition to an increase in remote workers, as well as a continued influx through the summer of 2021 and into 2022.[10]

Through 2050, the statewide unemployment rate is expected to remain consistently low at just over 3 percent. Correspondingly, this indicates a continuously tight labor market, similar to those economic conditions ongoing since 2021. Although a promising metric from the perspective of income and buying power, a tight labor market could also stifle industrial production, which could affect rail activity.

Figure 3.9 Maine Unemployment Rate, 1990 – 2050

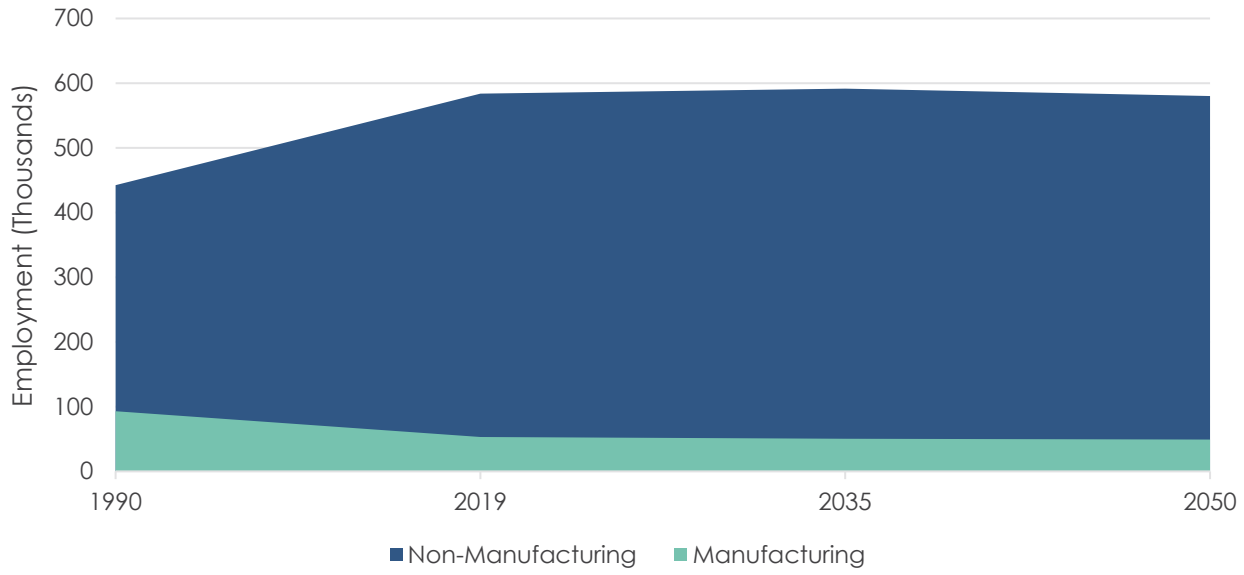


Source: S&P Global (2022)

[10] https://fox23maine.com/news/local/workers-from-massachusetts-helped-drive-pandemic-migration-to-maine#:~:text=From%20April%202020%20through%20March,1%2C500%20the%20year%20before%20that.

The following figures further examine the Maine economy based on employment by sector and industry. This breakdown allows for further analysis of statewide employment and economic patterns, as well as implications for freight patterns. As Figure 3.10 shows, the majority of jobs are associated with non-manufacturing sectors. Furthermore, manufacturing employment dropped between 1990 and 2019, even while total employment rose. Through 2050, total employment is expected to decline slightly to approximately 630,000 employees. This includes slight declines expected in both manufacturing and non-manufacturing sectors.

Figure 3.10 Total Employment by Sector Type, 1990 – 2050



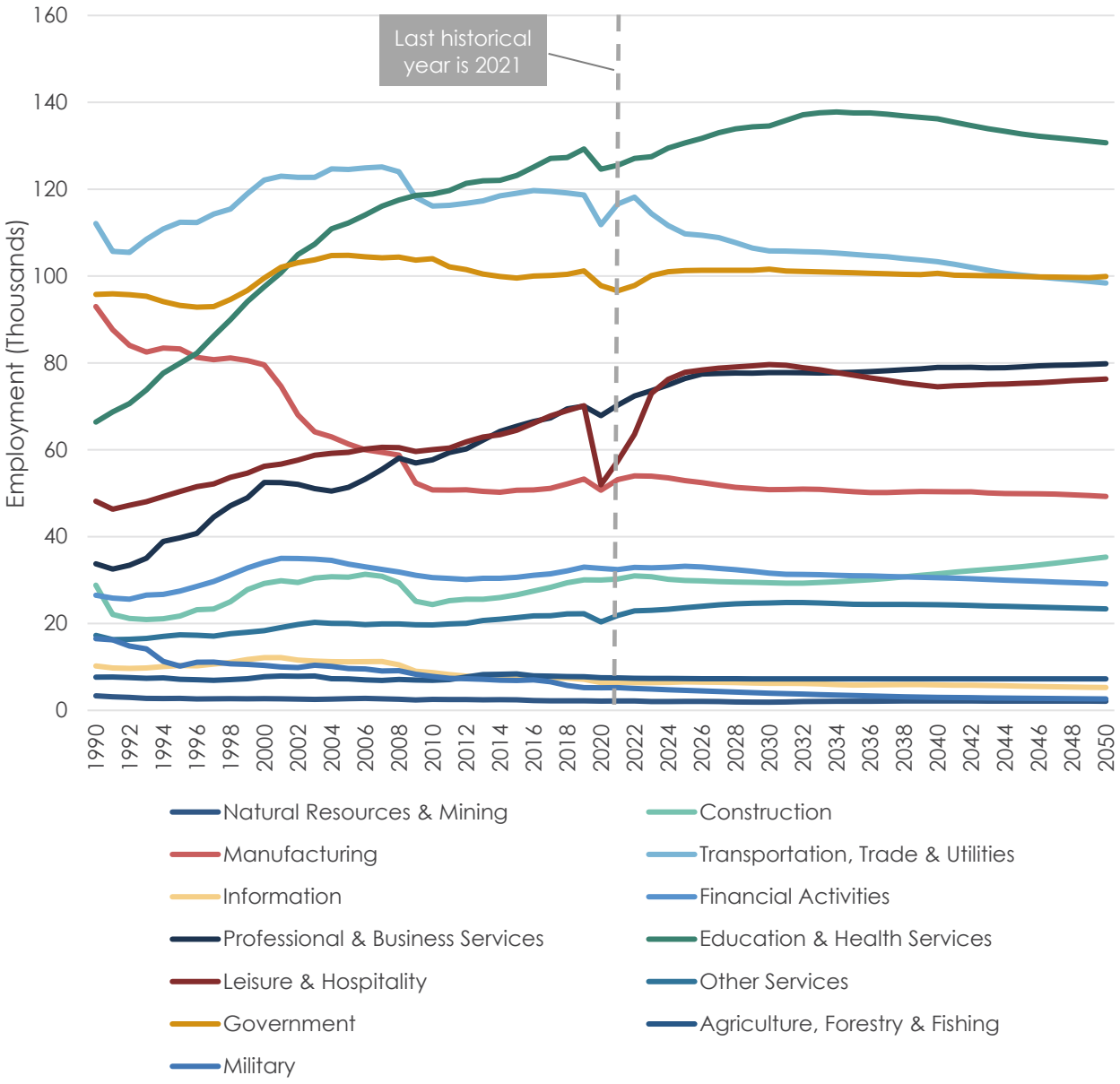
Source: S&P Global (2022)

Figure 3.11 further examines the composition of Maine's total employment, including historical and projected figures. Multiple inferences can be made from these figures. First, the majority of employment stems from a few key sectors. Top sectors across the entire 61-year period include Transportation, Trade & Utilities, Government, and Education & Health Services. From 1990 through 2021, these industries employed at least 60,000 people statewide. Employment in these three industries is expected to remain strong through 2050, with total employment in each of these industries remaining at or above 100,000.

On the other hand, there have been notable changes in employment composition since 1990. The most notable difference, as reflected in Figure 3.10 above, has been the decline of manufacturing. From a total of over 90,000 in 1990, manufacturing jobs have declined by

nearly half through 2020, a level that is expected to remain somewhat stable through 2050. At the same time, Education & Health Services employment has nearly doubled since 1990, and is expected to continue increasing through the 2030s. Sizable increases in employment have also occurred in Leisure & Hospitality and Professional & Business Services. As reflected in Figure 3.10, these trends largely fit a pattern of increased employment in industries outside of commodity and goods production that occurs in manufacturing sectors.

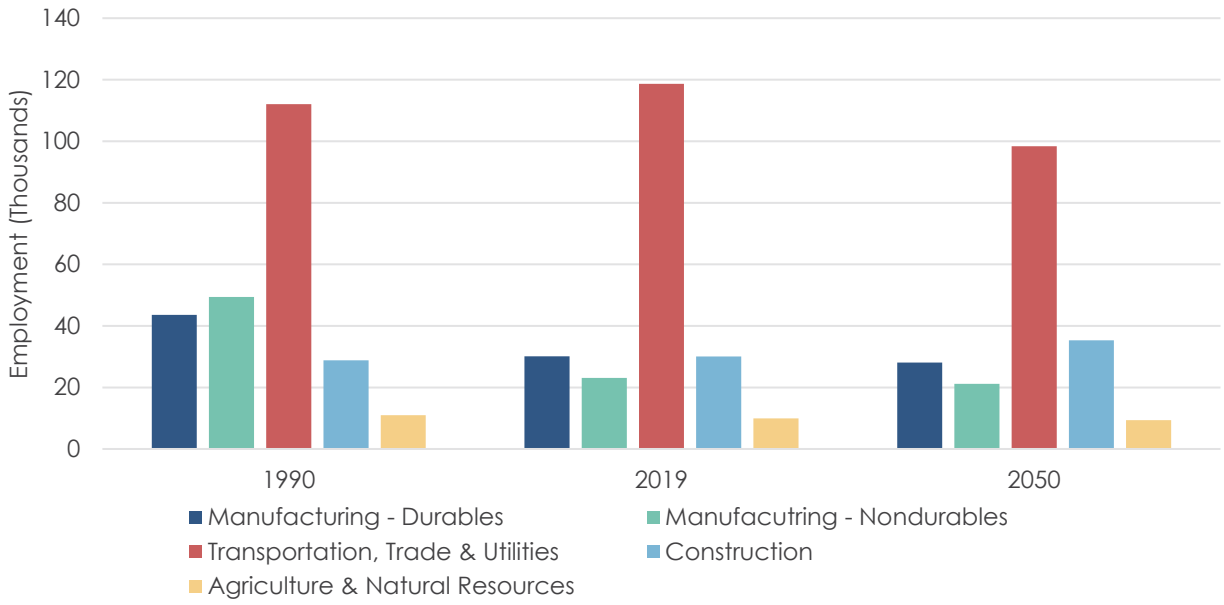
Figure 3.11 Maine Employment by Sector, 1990-2050



Source: S&P Global (2022)

The specific characteristics of each of the sectors identified in Figure 3.11 have various implications for the movement of people and goods alike, including by rail. For example, increased growth in jobs related to Professional & Business Services in the Portland area could produce increased demand for passenger rail travel from other areas such as Boston. These trends are especially relevant to the movement of freight, especially to and from freight-generating sectors and industries. As a means of further examining these trends in relation to freight activity, Figure 3.12 below examines employment across those industries that are freight intensive. This includes Durable and Non-Durable Manufacturing, Transportation, Trade & Utilities, Construction, and Agriculture & Natural Resources.

Figure 3.12 Employment for Key Freight Generating Industries, 1990 – 2050



Source: S&P Global (2022)

As Figure 3.12 indicates, employment in freight-generating industries is expected to decline through 2050, following stagnation between 1990 and 2019. These declines are particularly evident with a roughly 20 percent decline in Transportation, Trade & Utilities employment to just under 100,000 by 2050. These projected declines are offset slightly by increases in Construction employment.

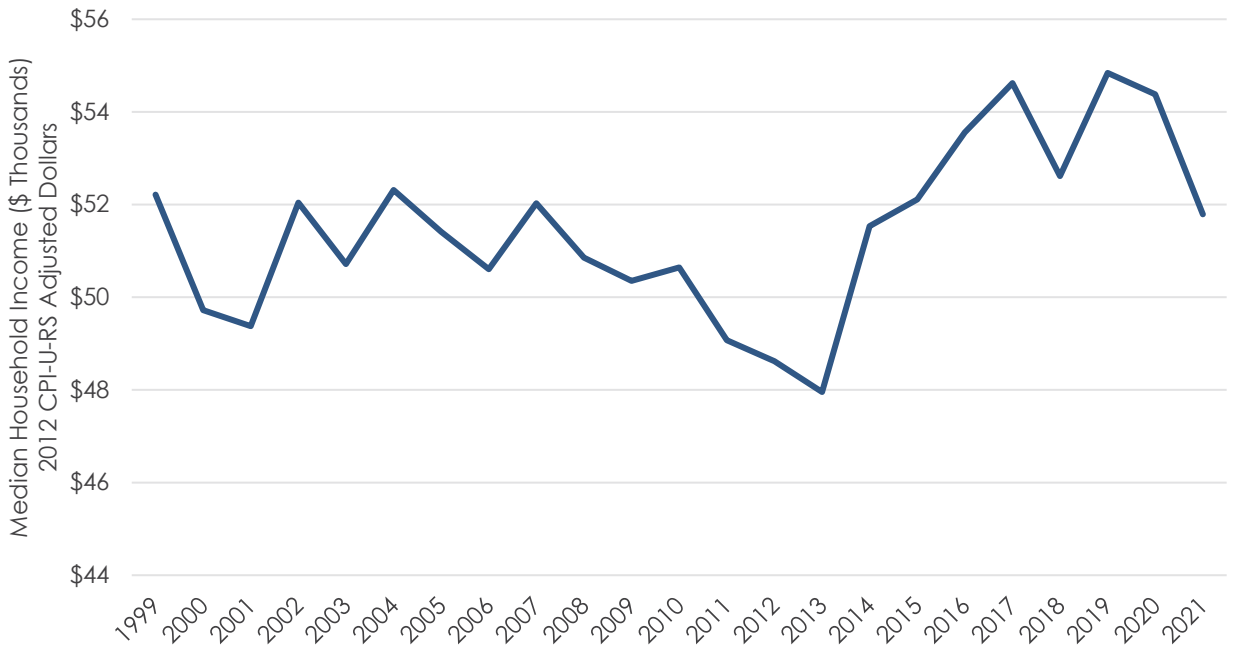
Although overall employment is expected to decrease slightly through 2050, the implications for rail activity are mixed. On the one hand, reduced employment both in freight generating and non-freight generating industries could result in reduced demand for goods movement.

However, reductions in employment in freight generating industries are also likely to be offset by increased automation and process efficiency. As a result, reduced employment in freight-intensive sectors may not be an indication of freight or rail activity.

3.1.3 Personal Income

Personal income directly relates to freight activity in that higher incomes spur increased demand for goods. As shown in Figure 3.13, when adjusted for inflation, the median household income in Maine has remained relatively steady since 1999 at approximately $52,000, measured in 2012 Dollars. In line with national trends, this has included two periods of decline during the post-2008 recession, as well as with the onset of the COVID-19 pandemic.

Figure 3.13 1999-2021 Real Household Income in Maine, 2012 Dollars

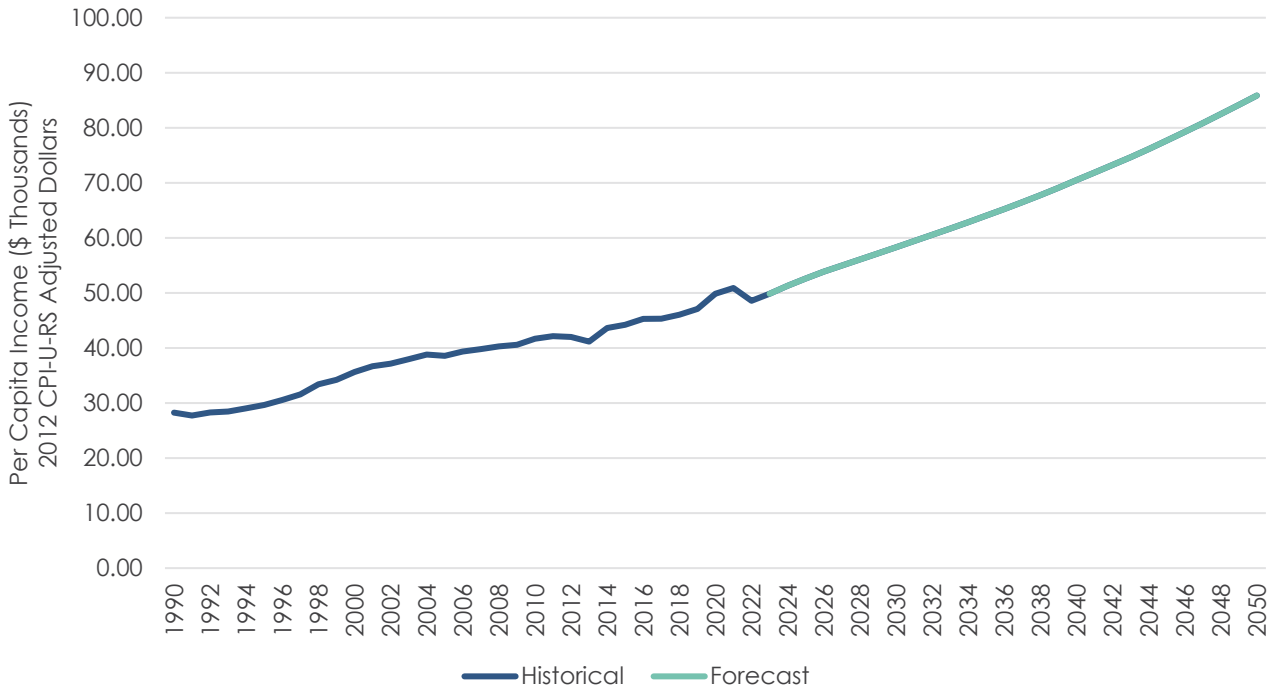


Source: S&P Global (2022)

Historical and expected per capita personal income is shown in Figure 3.14. Unlike household income, per capita income adjusts for household size, and is a more direct reflection of spending power. As shown in Figure 3.14, per capital personal income has risen relatively consistently between 1990 and 2022. Through 2050, per capita personal income is expected to rise to approximately $85,000, measured in 2012 Dollars. Over the long-term forecast, this

increase is expected even when accounting for potential and unforeseen impacts or shocks to the local, statewide, and national economies.

Figure 3.14 1990-2050 Actual and Forecast Maine Per Capita Personal Income, 2012 Dollars

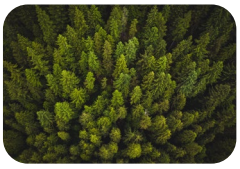


Source: S&P Global (2022)

3.2 Rail Freight Intensive Industries

This section focuses on key industries identified by the State of Maine as important drivers of the State's economy (Figure 3.15). Drawing on rail freight flow data, the following sections describe and analyze rail freight volumes and geographic distribution; and provide examples of the typical supply chains for each of these industries.

Figure 3.15 Industry Profile Focus Areas


Forest Products


Pulp and Paper Products


Agricultural Products

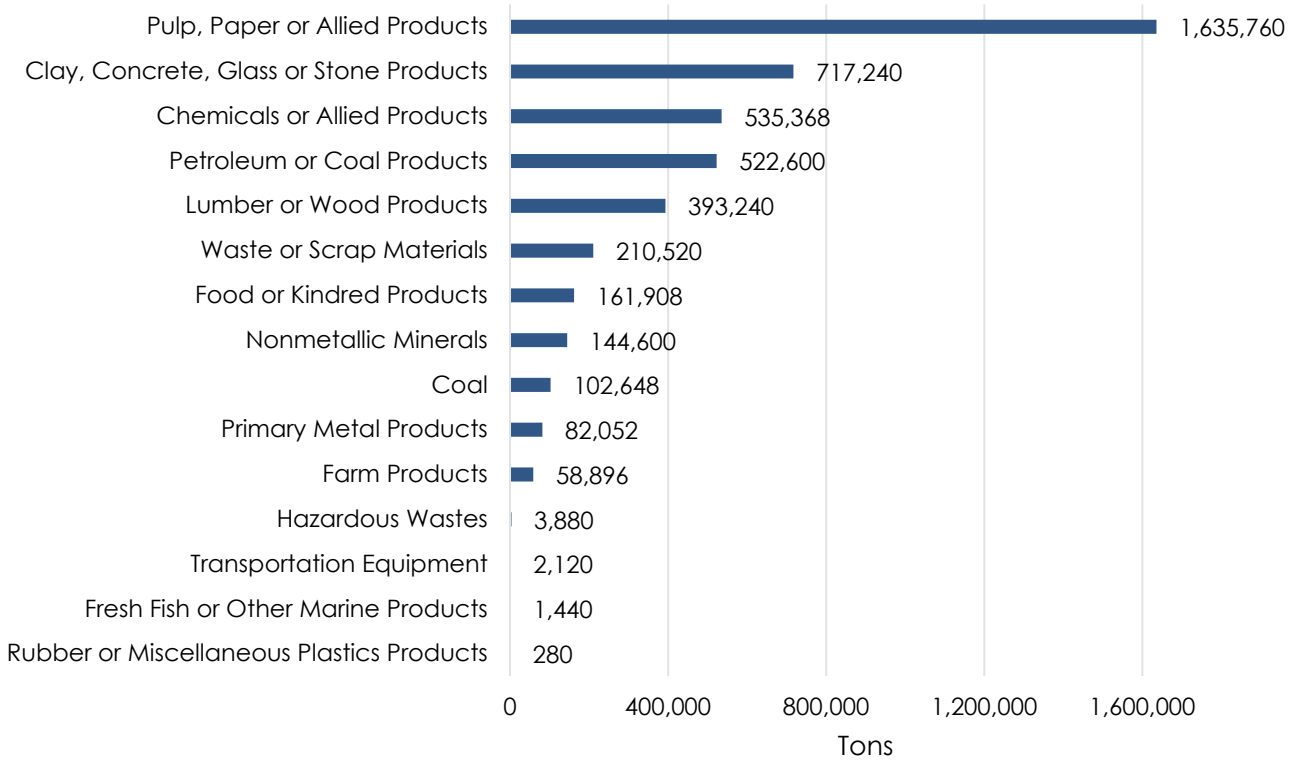

Petroleum Products


Chemical Products

Rail traffic is identified on waybills and other shipping documents by a seven-digit Standard Transportation Commodity Code (STCC) that identifies and categorizes commodities. The STCC numbers are organized into related groups in a hierarchical manner; the first two digits identify one of 38 major commodity groups, while the successive digits divide the group into logical subgroups. The analysis in this section discusses traffic handled by railroads operating in Maine that report their traffic for the STB Carload Waybill Sample.

In 2019, all reported commodities in Maine combined for almost 4.6 million tons and $4.4 billion in value of freight moving into, out of, within, and through Maine. Pulp, paper, and allied products was by far the largest industry in terms of tonnage (Figure 3.16), with 1.6 million tons moving in, out, within, and through the state. This industry includes commodities that are closely related to the state's forest products industry, such as pulp or pulp mill products; paper; and fiber, paper, or pulpboard.

Figure 3.16 Industries by Rail Tonnage, 2019

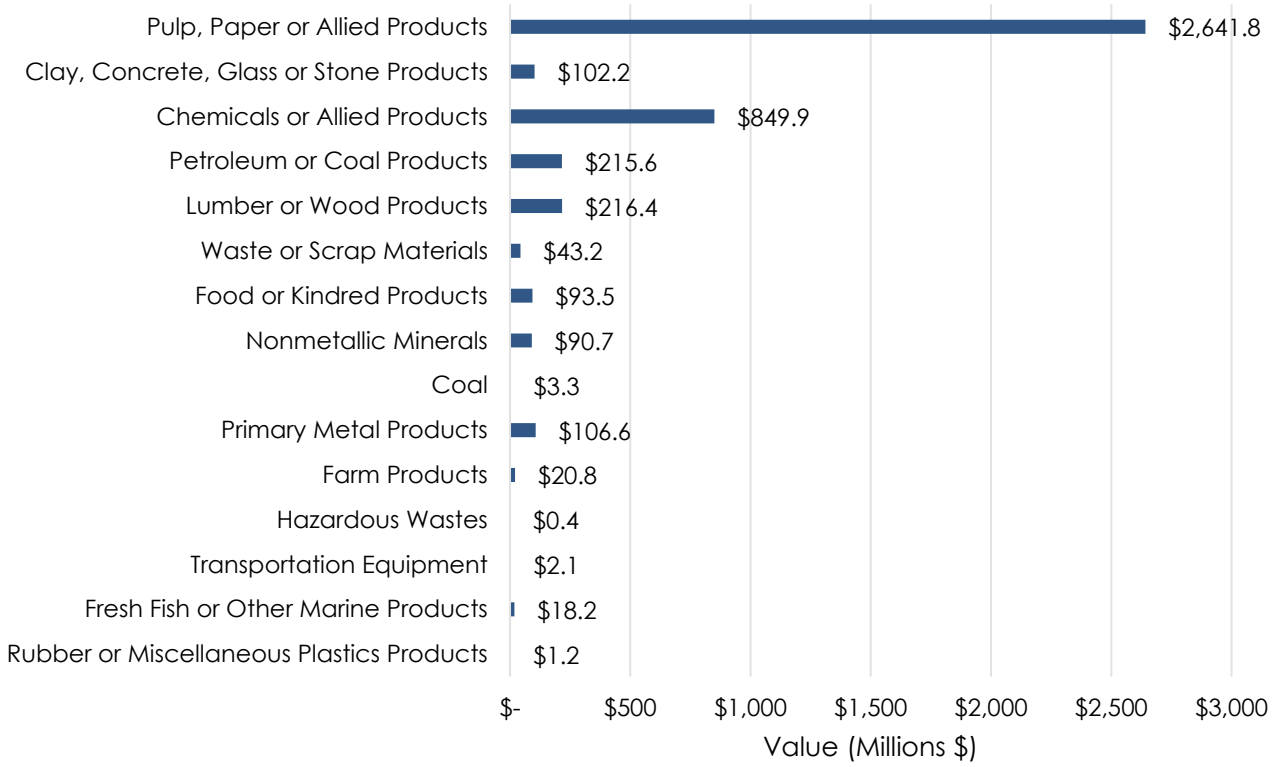


Source: STB Confidential Carload Waybill, 2019.

The second highest total tonnage was in clay, concrete, class, or stone products, which is intuitive given the weight of these products. Included in this larger industry are commodities such as Portland cement, gypsum products, and processed nonmetallic minerals. Two industries generate roughly equal tonnage in the state: chemicals or allied products and petroleum or coal products. These industries are investigated in greater detail in sections 1.1.5 and 1.1.4, respectively.

Figure 3.17 represents the corresponding value for the rail commodities moved in Maine's rail system. By this measure, pulp, paper, or allied products are the top commodity group accounting for 60 percent of the total value (inbound, outbound, intrastate, and through) or $2.6 billion in 2019. Chemicals or allied products followed in the second ranking for total value. This group, which was the third top commodity group by tonnage in 2019, accounted for 19 percent of the total value ($850 million) of all commodities.

Figure 3.17 Industries by Rail Value, 2019



Source: STB Confidential Carload Waybill, 2019, and commodity $ value per ton from S&P Global.

The subsequent sections provide additional detail on the key rail industries in Maine.

3.2.1Forest Products

Overview

Maine has abundant forest resources. Nearly 90 percent of the state, or 17 million acres, is forested, and these forests include a diverse mix of 56 percent hardwood (e.g. aspen, oak, and maple) and 44 percent softwood (e.g. pine and spruce). Particularly in the state's more rural counties, forest products comprise the backbone of the economy. In 2016, the economic impact of the forest products industry was estimated at $8.5 billion, equal to one out of every twenty dollars of the state gross domestic product (GDP). The industry sustains more than 33,500 jobs, which amounts to one out of every twenty-four jobs in Maine. Jobs in the forest products industry range from the harvesters and skidders who work in the forest; the truckers, who transport the lumber from the forest to various types of processors; employees

of Maine's paper mills, sawmills, board mills, and lumber companies; craftspeople who use processed lumber to create furniture and other finished products; and the accountants, mechanics, salespeople, and other support staff employed by companies in the industry. [11]

Demand for solid wood markets, including lumber and plywood for housing, is currently strong, and innovations in building materials and forest products offer Maine opportunities to diversify its markets for long-term economic stability. New building materials, such as engineered wood products, are gaining market share. New forest products and applications from wood, such as high-performance fibers, natural chemicals, and biofuels, are also proliferating. Maine's future forest economy will likely include a mix of traditional and new and emerging forest products that will diversify its portfolio of economic opportunities. Maine's *Forest Opportunity Roadmap* identifies the following opportunities in Maine's forest sector moving forward: [12]

- Traditional Wood Products:
  - **Sawn timber** will continue to be a critical component of Maine's forest economy. demand in the U.S. is largely driven by the construction of new housing, which is expected to continue to strengthen.
  - **Pulp and paper manufacturing** continues to be a leading commodity in Maine's forest economy. Maine's paper mills are shifting production away from print media and into tissue, labeling, and packaging grades of paper.
  - **Orientated Strand Board** (OSB) is an alternative to plywood. It is used extensively as a structural panel in construction. This technology is produced by two major facilities in Maine.
- New Wood Products:
  - **Cross-laminated timber** (CLT) is an engineered wood product that is especially well-suited for buildings between six and eighteen stories tall that traditionally utilize steel framing. Experts anticipate rapid growth in this technology. Two CLT facilities are planned to open in Maine.

[11] Forest Opportunity Roadmap / Maine (FOR/Maine), 2018. https://formaine.org/wp-content/uploads/2020/09/FORMaine_Report_DL_041119.pdf

[12] Forest Opportunity Roadmap / Maine (FOR/Maine), 2018. https://formaine.org/wp-content/uploads/2020/09/FORMaine_Report_DL_041119.pdf

- **Nanocellulose** consists of light and strong fibers that can be used in a variety of applications, from coatings for packaging papers to high performance textiles and medical products. The University of Maine is a global leader in the research and development of nanocellulose applications.[13]

» The roadmap also identifies several traditional and emerging wood products without current manufacturing capacity in Maine that may play a role in Maine's future economic opportunities in the industry:

- **Laminated veneer lumber** (LVL) is an engineered wood product used in residential construction that uses layers of dried wood veneer. No manufacturing currently exists in Maine.

- **Medium Density Fiberboard** (MDF) is a reconstituted wood-based panel product manufactured from pulpwood and sawmill residues. Over the past 20 years, laminate flooring and modern furniture has become a major end use for MDF. No manufacturing capacity exists in Maine.

- **Dissolving pulp** can be made into textiles (Viscose) and competes with cotton and synthetics (nylon and acrylic). There are no facilities with this capability currently in Maine.

Supply Chain Analysis

When trees are harvested, they are typically loaded onto logging trucks for transport. Typically, two types of trucks are utilized: one with a suspension that can manage the terrain where the trees are felled and the other for transport on conventional roadways. Once the raw logs are manufactured into other products at secondary locations, the products are distributed within Maine, to other states, and around the world using rail, truck, or ship depending on the distance and the destination. [14]

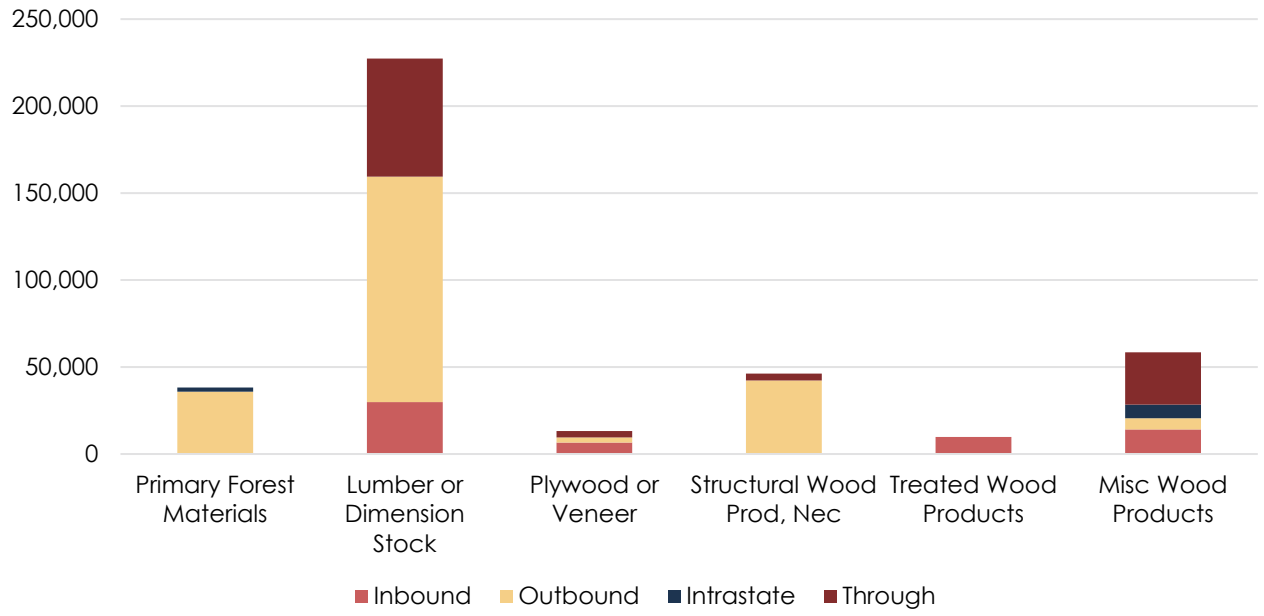
Commodities within the lumber or wood products industry include primary forest materials, lumber or dimension stock, plywood or veneer, structural wood products, treated wood

[13] Forest Opportunity Roadmap / Maine (FOR/Maine), 2018. https://formaine.org/wp-content/uploads/2020/09/FORMaine_Report_DL_041119.pdf

[14] Forest Opportunity Roadmap / Maine (FOR/Maine), 2018. https://formaine.org/wp-content/uploads/2020/09/FORMaine_Report_DL_041119.pdf

products, and other miscellaneous wood products.[15] A substantial portion of primary forest materials, lumber or dimension stock, and structural wood products flow outbound from Maine by rail, indicating the strength of these commodities as an export (Figure 3.18). The other major portion of lumber or dimension stock tonnage is Canadian lumber transiting Maine to U.S. markets. Treated wood products, the commodity with the smallest tonnage in this industry group, is the only commodity with only inbound freight traffic.

Figure 3.18 Forest Products – Rail Commodity Flows by Tonnage, 2019



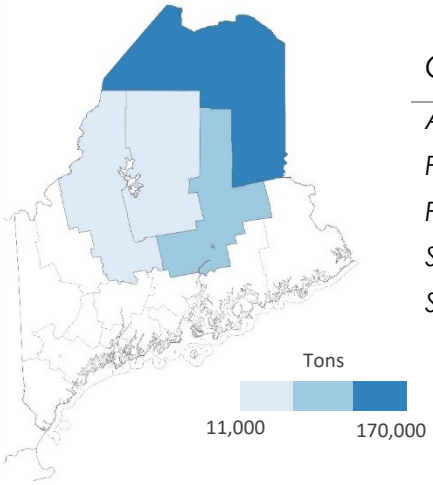
Source: STB Confidential Carload Waybill, 2019.

Maine's forest products are drawn from the forests of the state's northernmost and most rural counties (Figure 3.19). Aroostook County, Maine's northernmost county, is by far the greatest exporter of lumber, originating 167,520 tons in 2019.

Lumber and other forest products are distributed to a range of U.S. states and to Quebec. Though the largest destination by rail for Maine forest products in 2019 was Maine itself (43,200), other major destinations included North Carolina, Massachusetts, Wisconsin, and Illinois as shown in Figure 3.20.

[15] Although the STCC commodity classification system does include a "Forest Products" code (STCC 08), this category is limited to crude gums and barks and miscellaneous forest products. There is no rail tonnage or value reported under the STCC 08 code in Maine. Lumber and wood products (STCC 24) are commonly understood to be part of the broader definition of a forest products industry; as such, this analysis considers both 08 and 24 codes together as "forest products."

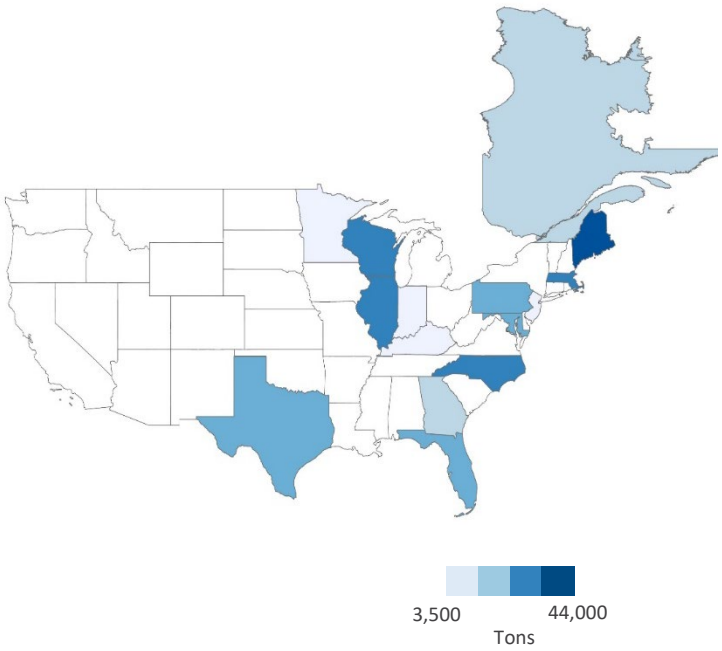
Figure 3.19 Forest Products Rail Shipment County Origins, 2019



County	Tonnage
Aroostook	167,520
Penobscot	41,920
Piscataquis	10,720
Somerset	7,200
Somerset	7,200

Source: STB Confidential Carload Waybill, 2019.

Figure 3.20 Forest Products Rail Shipment Destinations, 2019

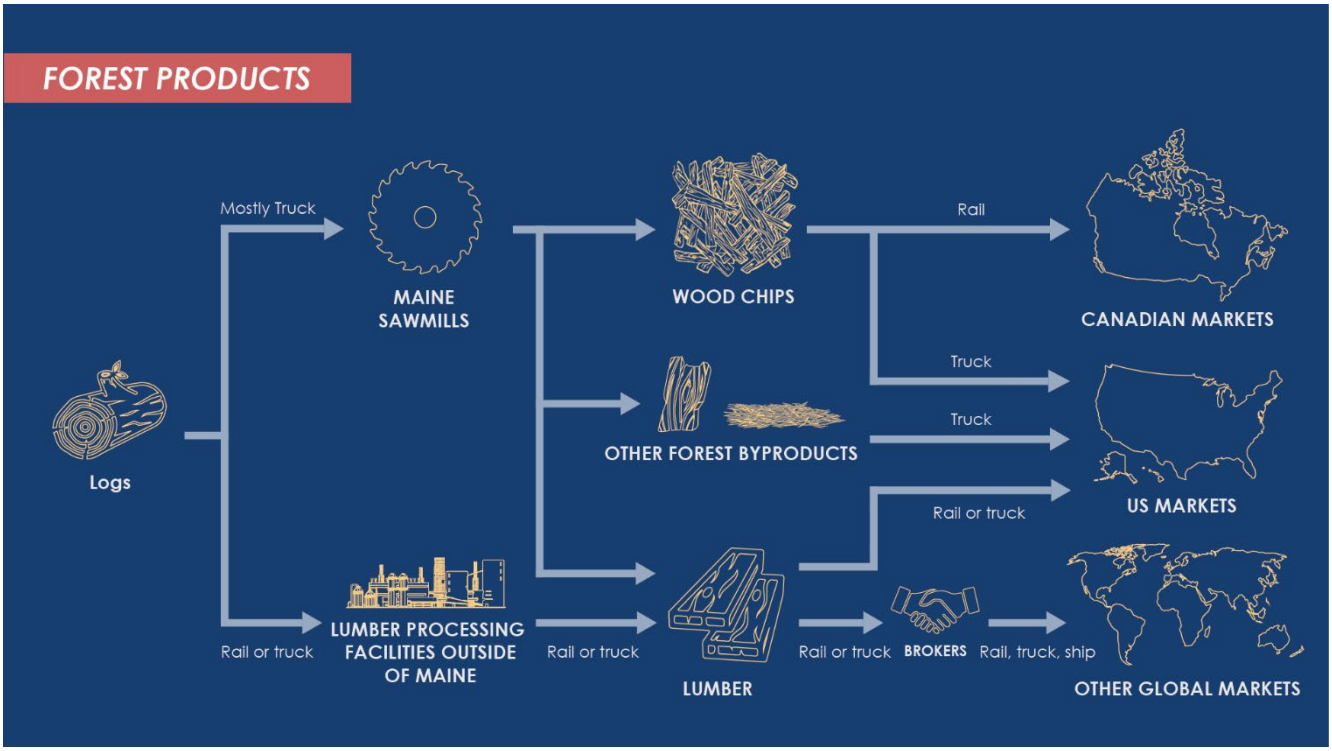


State/Province	Tonnage
ME	43,200
NC	29,200
MA	25,760
WI	22,400
IL	22,200
MD	14,840
PA	13,320
FL	11,480
TX	11,160
GA	7,080
VT	6,160
Quebec	5,680
IN	3,920
KY	3,840
MN	3,720
NJ	3,400

Source: STB Confidential Carload Waybill, 2019.

An example forest products supply chain is illustrated in Figure 3.21. Logs are transported from forests to Maine sawmills by truck, where they are processed into wood chips, other forest, byproducts, and lumber. They may also travel to out-of-state lumber processing facilities by a combination of truck and rail to be processed into lumber. These products are distributed to U.S., Canadian, and international markets through a combination of rail, truck, and ship, depending on distance to destination.

Figure 3.21 Example Forest Products Supply Chain in Maine



3.2.2Pulp and Paper Products

Overview

Pulp and paper manufacturing continues to be the leader in contributing to Maine's forest economy. Maine's paper mills are shifting production away from print media and into tissue, labeling and packaging grades of paper. Sawn timber continues to be the highest value to landowners of industry, while pulp and paper provides the greatest return to Maine's economy.

Worldwide, demand for newsprint, printing, and writing papers has declined in recent years. These rapid marketplace changes led to the closure of six Maine pulp and paper mills and

substantial job losses. On a percentage basis, job losses in the industry have been more significant in Maine than nationally. From 2015 to 2019, Maine lost 19 percent of its jobs in this industry, compared to five percent nationally. From 2019 through 2020, this trend continued, and state projections anticipated continued losses in the sector. [16] But even as some markets shrink, other paper products have begun filling market gaps. Global demand for packaging, labeling, and tissue paper is growing and is expected to continue to grow, providing new opportunities for Maine's paper industry.

Of the five industries that are key consumers of the output from Maine's pulp and paper mills, key challenges include changing consumer preferences, a shift to digital media, and competitive pressures: [17]

- **Cardboard box and container manufacturing**: Industry operators have seen strong demand due to the strength and prevalence of e-commerce, and revenue growth is expected to accelerate in coming years.
- **Coated and laminated paper manufacturing**: Import competition, offshoring trends in downstream industries, and a declining print media sector point to weak future demand for the industry. At the same time, there will likely be some level of stability due to the wide range in uses for the industry products, demand from food manufacturers and in increasing attention to environmentally-friendly products (e.g., paper rather than plastic packaging).
- **Office stationary manufacturing**: Products for this market face challenges from the trend towards digitization and this industry has a weak long-term outlook.
- **Sanitary paper product manufacturing**: Demographic trends are likely to benefit the industry in the future (e.g., population growth generally, a growing elderly population that fuels demand for incontinence products), while a shift in consumer preferences towards reusable products poses a threat.
- **Paper product manufacturing**: This industry has contended with competitive pressure from substitute products and low-cost imported goods. The industry is vulnerable to macroeconomic factors, as many paper products in the industry are considered

[16] Pulp and Paper Market Profile, 2022. https://www.maine.gov/decd/sites/maine.gov.decd/files/inline-files/Market%20Profile%20%20-%20Pulp%20and%20Paper%20Products%20-%20State%20of%20Maine%20DECD.pdf

[17] Pulp and Paper Market Profile, 2022. https://www.maine.gov/decd/sites/maine.gov.decd/files/inline-files/Market%20Profile%20%20-%20Pulp%20and%20Paper%20Products%20-%20State%20of%20Maine%20DECD.pdf

discretionary. Given a strong macroeconomic outlook, the industry would be expected to thrive, and vice versa.

» **Printing**: Although industry operators expect continued revenue losses to digital media, the continued value of print advertisements to marketing campaigns may somewhat temper the pace of the industry's decline.

There are recent signs of optimism and significant investment in the future of Maine's paper products industry, including Woodland's $150 million investment to make tissue at its Baileyville mill, Sappi's $165 million upgrade of a paper machine at its Somerset Mill in Skowhegan, Verso Corporation's $17 million upgrade of a paper machine at the Androscoggin Mill in Jay, a $12 million expansion at Pleasant River Lumber's sawmill in Dover Foxcroft, a $30 million biomass plant investment at Athens Energy, a $36 million biomass plant investment in Robbins Lumber in Searsmont, and the announcement that two Cross-laminated Timber (CLT) plants will soon be built in Maine. [18]

Supply Chain Analysis

The paper products supply chain is closely linked with that of Maine's forest products industry. Once raw logs are manufactured into other products, including pulp and chips, at secondary locations, the products are distributed within Maine, to other states, and around the world using rail, truck, or ship. Some of the pulp produced at secondary locations continues on to paper mills, where it is converted into various pulp and paper products, including paper, fiber, and pulpboard.

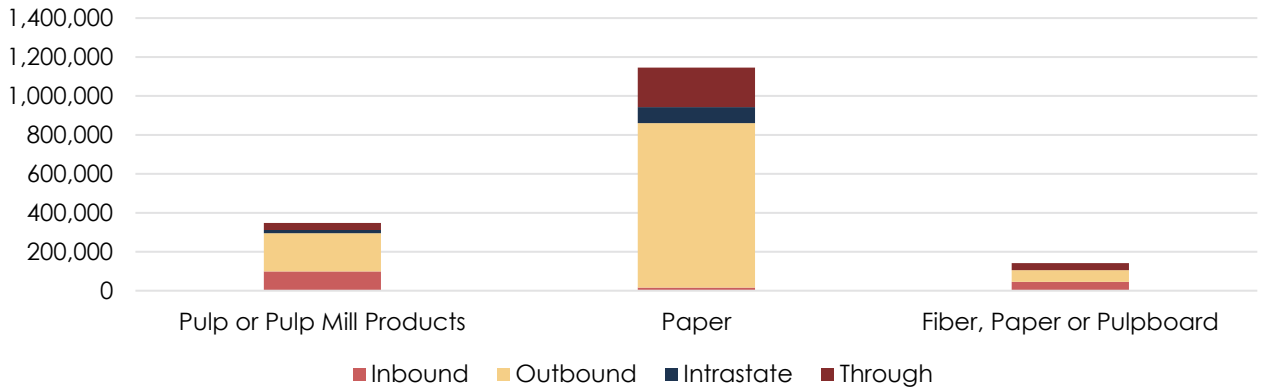
Maine's paper mills sell their products as inputs to businesses in other industries. Within Maine, the corrugated and solid fiber box manufacturing industry is the largest consumer of products from paper mills. Other key industries that paper mills sell to include Commercial Printing, Sanitary Paper Product Manufacturing, and Other Paperboard Container Manufacturing. Within Maine, pulp mills sell most of their outputs to other paper and pulp mills. [19]

[18] Forest Opportunity Roadmap / Maine (FOR/Maine), 2018. https://formaine.org/wp-content/uploads/2020/09/FORMaine_Report_DL_041119.pdf

[19] Pulp and Paper Market Profile, 2022. https://www.maine.gov/decd/sites/maine.gov.decd/files/inline-files/Market%20Profile%20%20-%20Pulp%20and%20Paper%20Products%20-%20State%20of%20Maine%20DECD.pdf

Much of the rail traffic carrying these commodities is outbound, reflecting the fact that this industry is an export industry in Maine (Figure 3.22). Ninety-five percent of the industry's $2.2 billion in annual sales are made to consumers out of state, both domestic and foreign. [20]

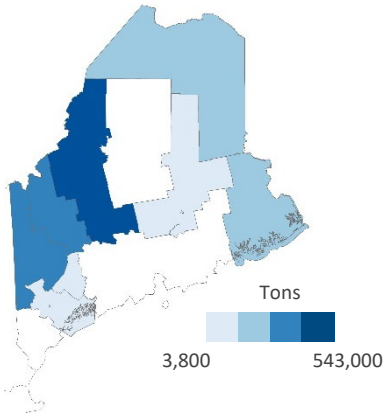
Figure 3.22 Pulp, Paper, or Allied Products – Rail Commodity Flows by Tonnage, 2019



Source: STB Confidential Carload Waybill, 2019.

Though some of Maine's pulp and paper products originate in the state's northernmost counties that are also major centers of the forest products industry, western counties such as Somerset, Franklin, and Oxford are the largest origin counties for these commodities (Figure 3.23). Sappi's mill in Skowhegan is located in Somerset County, the county with the largest single output in rail tons in 2019.

Figure 3.23 Pulp and Paper Products Rail Shipment County Origins, 2019

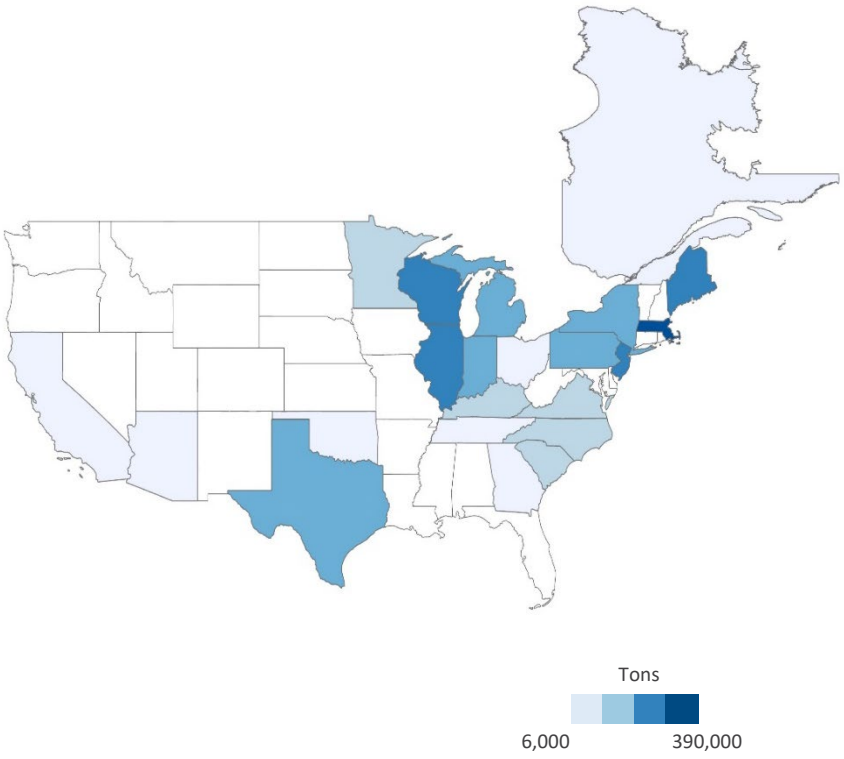


County	*Tonnage*
Somerset	543,600
Franklin	256,360
Oxford	214,760
Aroostook	151,160
Washington	23,320
Penobscot	3,800
Cumberland	3,800
Androscoggin	3,760

Source: STB Confidential Carload Waybill, 2019.

[20] Ibid.

Figure 3.24 Pulp and Paper Products Rail Shipment Destinations, 2019

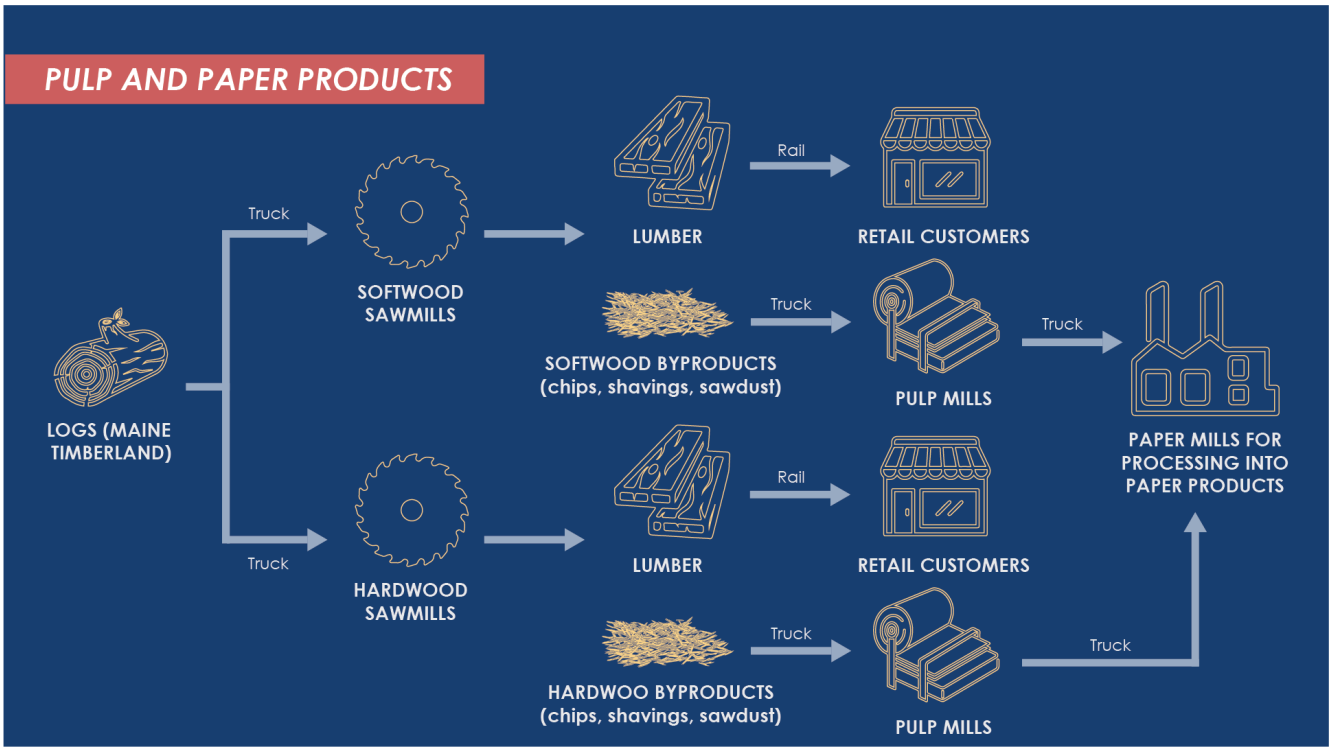


State/Province	Tonnage
MA	383,560
NJ	165,880
IL	102,320
ME	99,040
WI	84,600
IN	43,960
MI	40,880
NY	40,520
TX	37,680
PA	37,120
NC	25,200
MN	23,280
KY	20,280
VA	19,160
SC	16,840
GA	13,760
AZ	11,920
OH	11,040
TN	7,120
Quebec	6,640
CA	6,600
OK	3,160

Source: STB Confidential Carload Waybill, 2019.

The pulp and paper products supply chain is in many cases embedded in the forest products industry supply chain illustrated in Figure 3.21; pulp is among the "other forest byproducts" that may be processed at Maine sawmills. Figure 3.25 illustrates another path that forest products may take on their way to the pulp and paper products sector. Rather than being converted to lumber at sawmills, some hardwood and softwood products are converted to other forest byproducts, which travel to pulp mills and paper mills to be processed into paper products.

Figure 3.25 Example Pulp and Paper Products Supply Chain



3.2.3 Agricultural and Food Products

Overview

Maine farmers are the stewards of 1.25 million acres, and the agricultural industry has a $1.2 billion impact on the Maine economy. Maine has the third highest percentage of food manufacturing exports among New England states, at 76 percent of total industry sales. Maine ranks in the middle of the New England states in terms of total food sales per capita, at $1,302 (Massachusetts and Vermont exceed this number).[21] These exports are driven, in turn, by Maine's diverse agricultural sector. Maine is the world's largest producer of wild blueberries and brown eggs, and has earned global recognition for its milk, cheeses, potatoes, apples, produce, maple syrup, and livestock.[22] The small, diversified farms across

[21] Maine Department of Economic and Community Development, 2022. *Food Product Manufacturing Exports*. https://www.maine.gov/decd/sites/maine.gov.decd/files/inline-files/Market%20Profile%20%20-%20Food%20Product%20Exports%20-%20State%20of%20Maine%20DECD%20%28003%29.pdf

[22] Senator Angus King, 2022. https://www.king.senate.gov/about/issues/agriculture

Maine supply niche markets with organic produce and meat, value-added products as well as fiber products.[23]

The industries within the agriculture and food processing sector require a wide range of transportation and logistics services to move raw agricultural commodities (e.g., grains, vegetables, fruits, livestock), agricultural inputs (e.g., fertilizer, pesticides), and foods products for intermediate or final consumption. Some products, such as grain, that are bulky and lower-value are often transported at lower unit costs by water and rail modes. Other commodities, such as fresh fruits, vegetables and meats, are highly perishable and high-value items and rely on refrigerated trucks and railcars, refrigerated cargo ships, and air cargo. Cold chain logistics has transformed the farming industry by providing facilities with several storages areas with different temperature settings to handled regular grocery goods at ambient temperature, produces, dairy, meat and frozen products, where significant amount of perishable food products can be received, stored, sorted and assembled into loads bound for respective grocery stores.

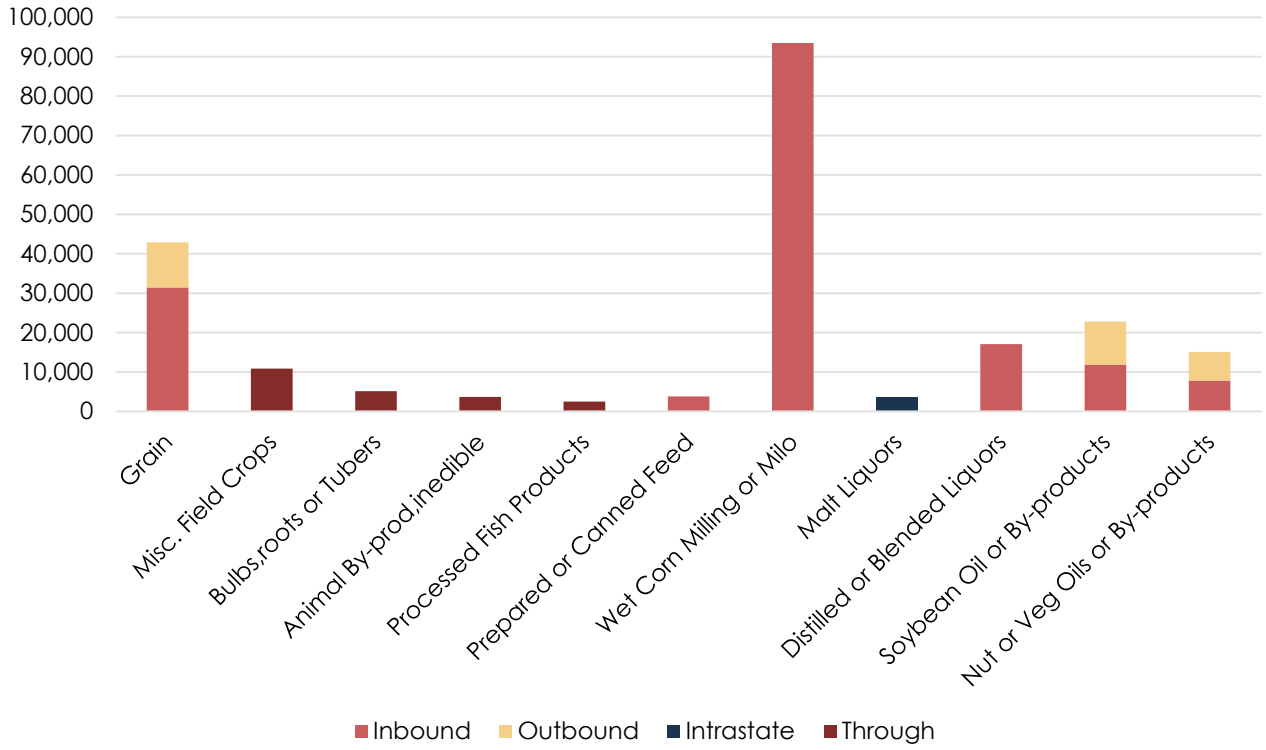
Supply Chain Analysis

This analysis considers both the farm products and food and kindred products industries to be part of Maine's agricultural products. The farm products industry includes commodities such as grain; other field crops; and bulbs, roots, or tubers. The food and kindred products industry includes commodities such as animal byproducts, processed fish products, prepared or canned feed, wet corn milling or milo, malt liquors, distilled or blended liquors, soybean oil or by-products, and nut or vegetable oils or by-products.

Agricultural and food products traveling out of Maine by rail include grain, soybean oil or by-products, and nut or vegetable oils or by-products (Figure 3.26). There is substantial inbound traffic of wet corn milling or milo as well as distilled or blended liquors. The remaining traffic in agricultural commodities is largely through traffic.

[23] https://www.nasda.org/organizations/maine-department-of-agriculture-conservation-and-forestry#:~:text=Agriculture%20in%20the%20state%20has,in%20milk%20and%20livestock%20production

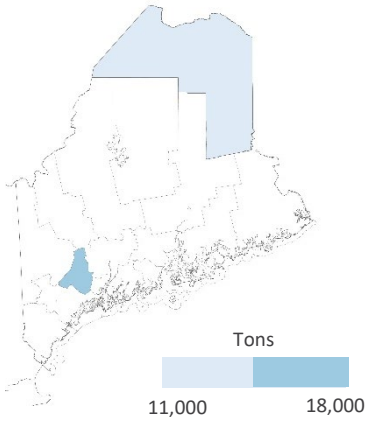
Figure 3.26 Agricultural and Food Products – Rail Commodity Flows by Tonnage, 2019



Source: STB Confidential Carload Waybill, 2019.

Much of the outbound traffic originates in Aroostook County (agricultural products) or Androscoggin County (food products) (Figure 3.27).

Figure 3.27 Agricultural and Food Products Rail Shipment County Origins, 2019



County	*Tonnage*
Androscoggin	18,200
Aroostook	11,440

Source: STB Confidential Carload Waybill, 2019.

Almost 70 percent of Maine agricultural products shipped by rail are destined for Quebec, Canada, with the remaining 30 percent destined for Vermont (Figure 3.28). In terms of tonnage, food products destined for Massachusetts far outweigh the combined tonnage to Vermont and Quebec.

Figure 3.28 Agricultural and Food Products Rail Shipment Destinations, 2019

State/Province	*Tonnage*
Massachusetts	18,200
Quebec	7,840
Vermont	3,600

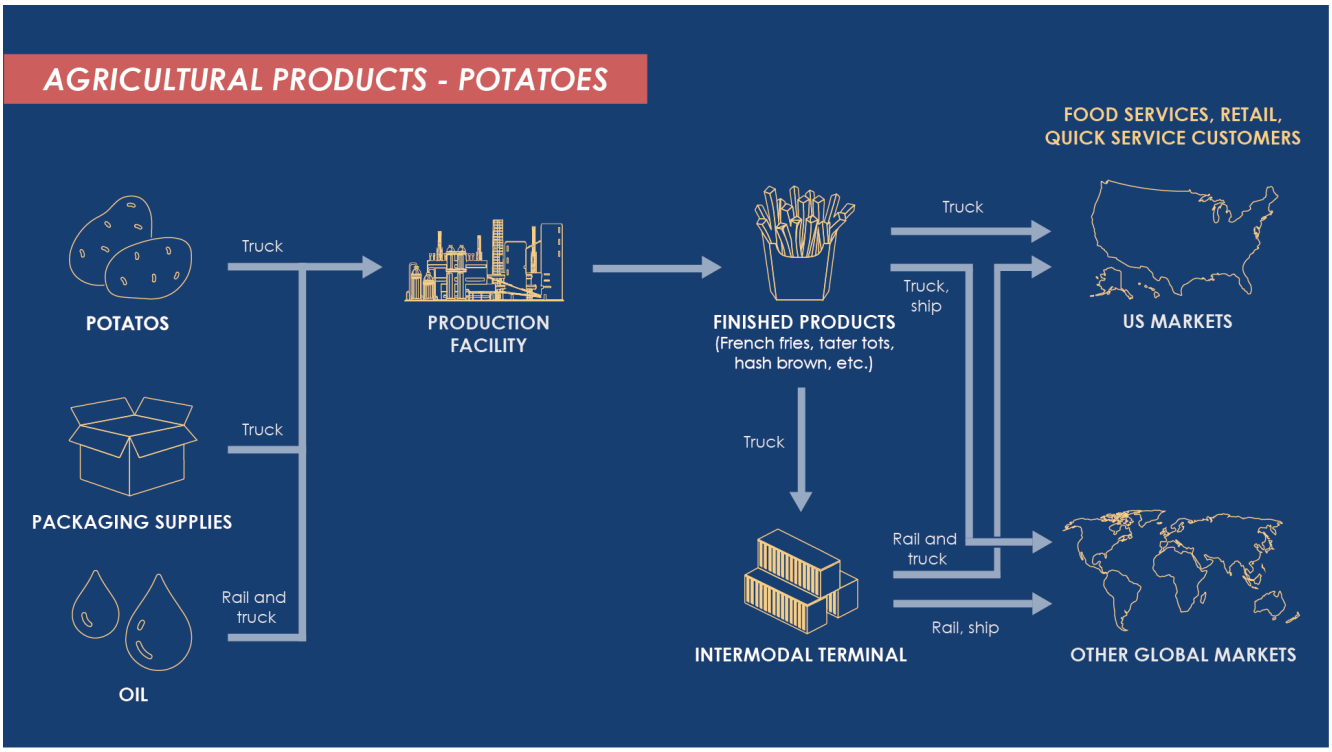
Source: STB Confidential Carload Waybill, 2019.

In northern Maine, the potato is the primary agricultural product. Over time, potatoes have shifted away from table stock and into specialty markets; nearly 25 percent of Maine's potato production is for seed to supply the east coast. Another 45 percent is used for French fry processing, 20 percent for potato chips and 10 percent for the fresh market for home, restaurant and institutional raw potato use. Recent economic impact studies of the potato industry on Maine's economy finds total sales in excess of $540 million with total employment of 6,150 jobs.[24] Figure 3.29 offers an illustrative supply chain for the Maine potato. In this case, materials required for the production of potato food products, including packaging and oil, are transported by truck or rail to production facilities. After potatoes are trucked to

[24] Aroostook County Tourism, 2022. *The Maine Potato.* https://visitaroostook.com/story/the-maine-potato

production facilities, finished potato products travel by truck directly to U.S. markets or through an intermodal facility to travel to global markets or U.S. markets farther afield.

Figure 3.29 Example Agricultural and Food Products Supply Chain in Maine



3.2.4 Petroleum Products

Overview

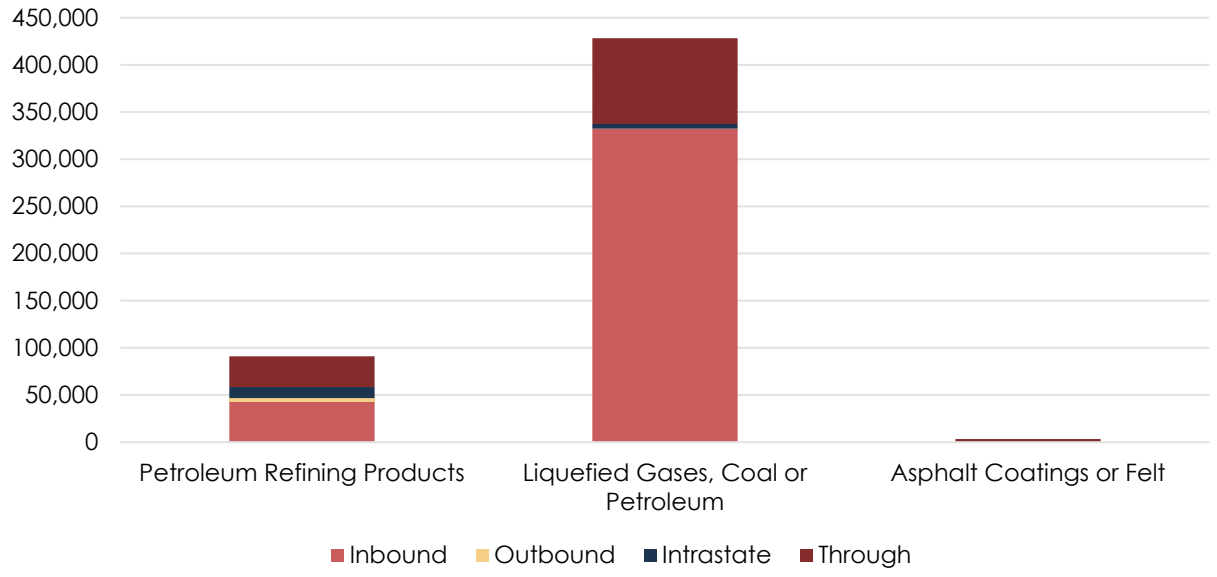
Petroleum accounts for the largest share of energy consumed in Maine and meets more than two-fifths of the state's energy needs. Three-fifths of the petroleum consumed in Maine is used in the transportation sector, and almost half of this portion is consumed as motor gasoline. Another quarter of the petroleum in the state is used as fuel to heat homes; in Maine, three out of every five households use fuel oil as their primary energy source. Transportation and home heating fuel consumption together help make Maine second, after Vermont, in per capita petroleum use among the New England states.

Supply Chain Analysis

Commodities in the petroleum or coal products industry shipped by rail in Maine include petroleum refining products, coal or liquefied gases, petroleum, and asphalt coatings or felt.

Given the role of petroleum products as a source of energy in Maine, it is intuitive that the vast majority of petroleum products are flowing into Maine (Figure 3.30).

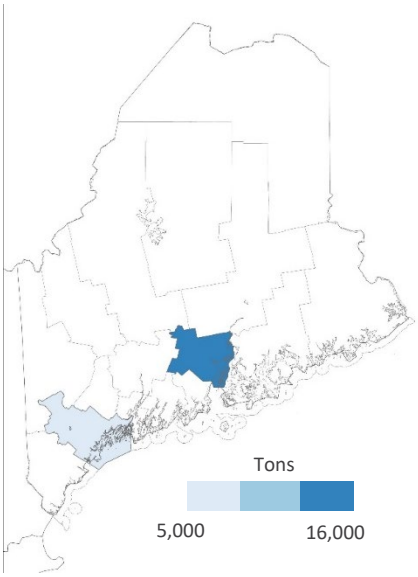
Figure 3.30 Petroleum Products – Rail Commodity Flows by Tonnage, 2019



Source: STB Confidential Carload Waybill, 2019.

There is a very small amount of outbound rail for this industry, and Figure 3.31shows the Maine county origins for the products moving within Maine.

Figure 3.31 Petroleum Products Rail Shipment County Origins, 2019



County	*Tonnage*
Waldo	15,720
Cumberland	4,960

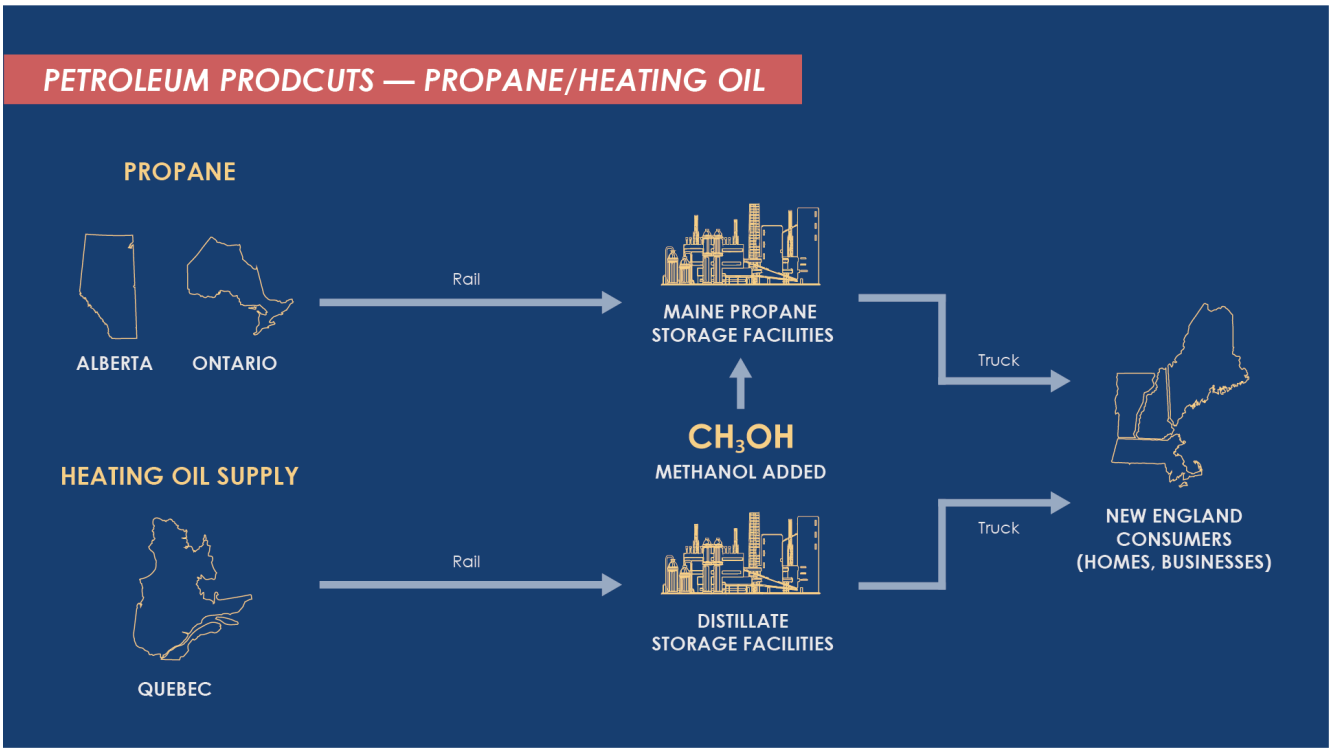
Source: STB Confidential Carload Waybill, 2019.

Major propane terminals serving Maine are located in Portsmouth, New Hampshire and in Biddeford, Auburn, and Portland, Maine. Smaller propane facilities are located throughout the state and provide year-round fuel supply and storage. As reported in the 2017 Freight Plan, propane by rail on PAR grew from one terminal in 2000 accepting 500 cars to 10 terminals accepting 10,000 carloads by 2017. This trend has continued in subsequent years. In Portsmouth, New Hampshire, the Sea 3 Company stores up to 26,500,000 gallons. Propane is shipped to Maine by rail through Lac Mégantic, Quebec and also transported by rail from New Brunswick's St. John refinery. Biddeford stores and distributes propane inbound 15 railcars per week, stored in 2.5 million-pound capacity tanks (30,000 gallons each). Propane is transported by truck to as far north as Augusta from Biddeford.[25]

Figure 3.32 offers an example of the supply chain for petroleum products transported in Maine. Propane and heating oil may be imported by rail from Canada and taken to propane storage facilities and distillate storage facilities, respectively, in Maine. This propane and heating oil is then transported by truck to residential and business customers in Maine. Customers include only New England states because shippers prefer to minimize the length of truck hauls for propane. They thus generate little interstate traffic beyond immediately adjacent states for this commodity.

[25] Maine Integrated Freight Strategy. https://www.maine.gov/mdot/ofps/docs/MaineDOT-FreightStrategy-Updt20171114.pdf

Figure 3.32 Example Petroleum Products Supply Chain in Maine



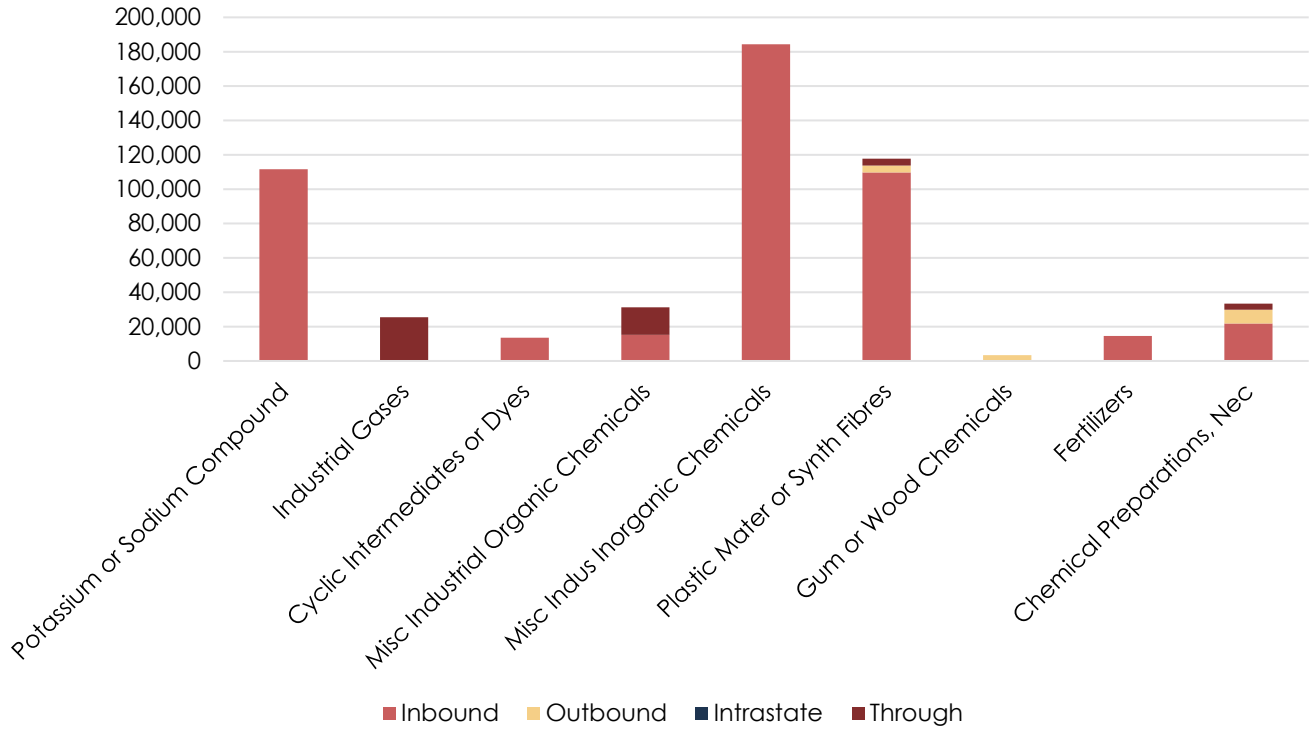
3.2.5Chemical Products

Overview

The chemical products industry includes the following commodities shown in Figure 3.33, many of which are associated with use in the pulp and paper products industry. The rail commodity flows illustrate the extent to which these products are generally used to support other Maine industries. The vast majority of all chemical products moved by rail in Maine are inbound, with some through traffic of industrial gases and inorganic chemicals (Figure 3.33).

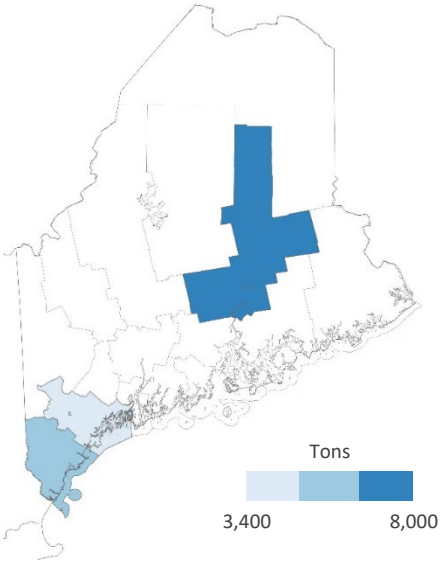
Outbound rail chemical products tonnage is low compared to other freight-intensive industries in Maine. Commodities include chemical preparations not elsewhere classified, gum or wood chemicals, and plastic mater or synthetic fibers. Penobscot County represents the origin of the majority of outbound tonnage as shown in Figure 3.34.

Figure 3.33 Chemical Products – Rail Commodity Flows by Tonnage, 2019



Source: STB Confidential Carload Waybill, 2019.

Figure 3.34 Chemical Products Rail Shipment County Origins, 2019

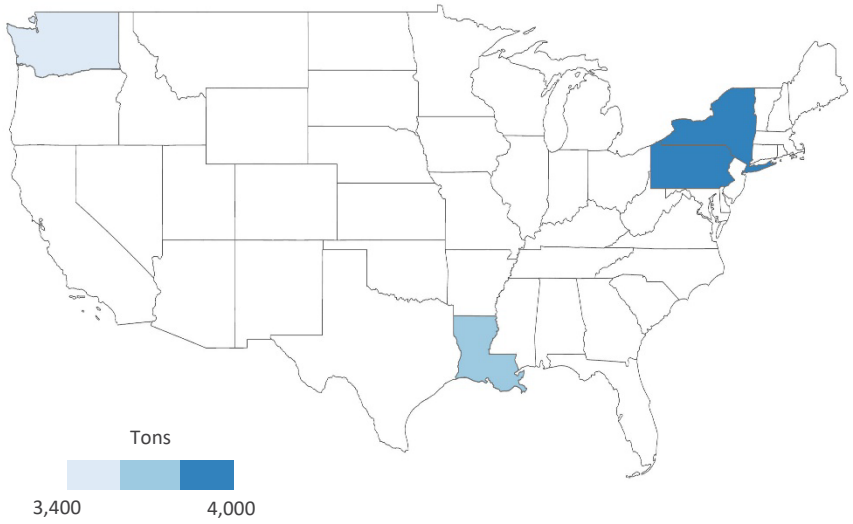


County	*Tonnage*
Penobscot	8,000
York	3,960
Cumberland	3,440

Source: STB Confidential Carload Waybill, 2019.

Chemical products originating in Penobscot are destined for New York and Pennsylvania, while other commodities travel farther afield to Washington and Louisiana (Figure 3.35).

Figure 3.35 Chemical Products Rail Shipment Destinations, 2019



State	Tonnage
PA	4,000
NY	4,000
LA	3,960
WA	3,440

Source: STB Confidential Carload Waybill, 2019.

Supply Chain

The chemical supply chain is closely related to that of pulp and paper products, as indicated in Table 3.1. The vast majority of chemical products are imported for use in this industry. The Pulp and Paper Products Supply Chain example (Figure 3.25), includes pulp and paper mills, which are major importers of the chemicals described below.

Table 3.1 Chemical Commodities Industry Uses

Chemical	Uses
Potassium or Sodium Compound	Pulp and paper products
Industrial Gases	Pulp and paper products
Cyclic Intermediates or Dyes	Pulp and paper products
Misc. Industrial Organic Chemicals	Pulp and paper products
Misc. Indus Inorganic Chemicals	Pulp and paper products
Plastic Mater or Synth Fibers	Pulp and paper products
Gum or Wood Chemicals	Pulp and paper products
Fertilizers	Agricultural products
Chemical Preparations, Not Elsewhere Classified	Pulp and paper products

3.2.6 Intermodal

Overview

A major opportunity for Maine lies in intermodal transportation. Intermodal rail terminals are locations within a rail network where freight shipments switch between rail and highway modes in intact trailers and containers. This mode leverages the distinct attributes of rail, highway, air and water modes to provide an efficient and low-cost multimodal transportation solution.

Intermodal train service is usually competitive only on movements of more than 500 miles, i.e. more than one day's drive for a truck. Most short line or regional rail carriers do not have that length of haul available within their networks, and thus generally do not handle this traffic. Exceptions to this rule include Maine, where both the SLR and Pan Am had at times provided intermodal service in Maine.

Presently, there is one active intermodal facility in Maine. At the **Waterville Intermodal Facility** CSX (formerly PAR) originates a dedicated water train (the "Poland Spring Express") that serves all three Poland Spring plants. From Waterville, containers are loaded onto rail cars and transported to Rigby Yard in South Portland for rail transport to Massachusetts. When Poland Spring launched the intermodal initiative in 2016, the operation added 60 containers to the train destined for Massachusetts and accounted for approximately 4,000 containers annually.[26] The facility consists of two long loading tracks and storage areas, as well as staging room for other facilities.

In addition to the Waterville terminal, two intermodal facilities are currently inactive:

- **Auburn Intermodal Facility**: Located on the SLA, the Auburn facility consists of two 1,200 foot long tracks that accommodate transfer of containers and trailers between truck and rail. Volumes declined by more than half from 12,000-15,000 loaded containers and trailers per year in the late 1990's to about 4,000-5,000 loads per year by approximately 2014. This terminal is less than three miles from I-95 and is 140 miles North of Boston. Typical inbound goods via rail from West Coast ports included consumer goods for L.L. Bean in Freeport and wine from California bound for liquor stores in New Hampshire. The Auburn

[26] https://www.centralmaine.com/2016/04/08/poland-spring-expands-rail-initiative-at-waterville-facility/

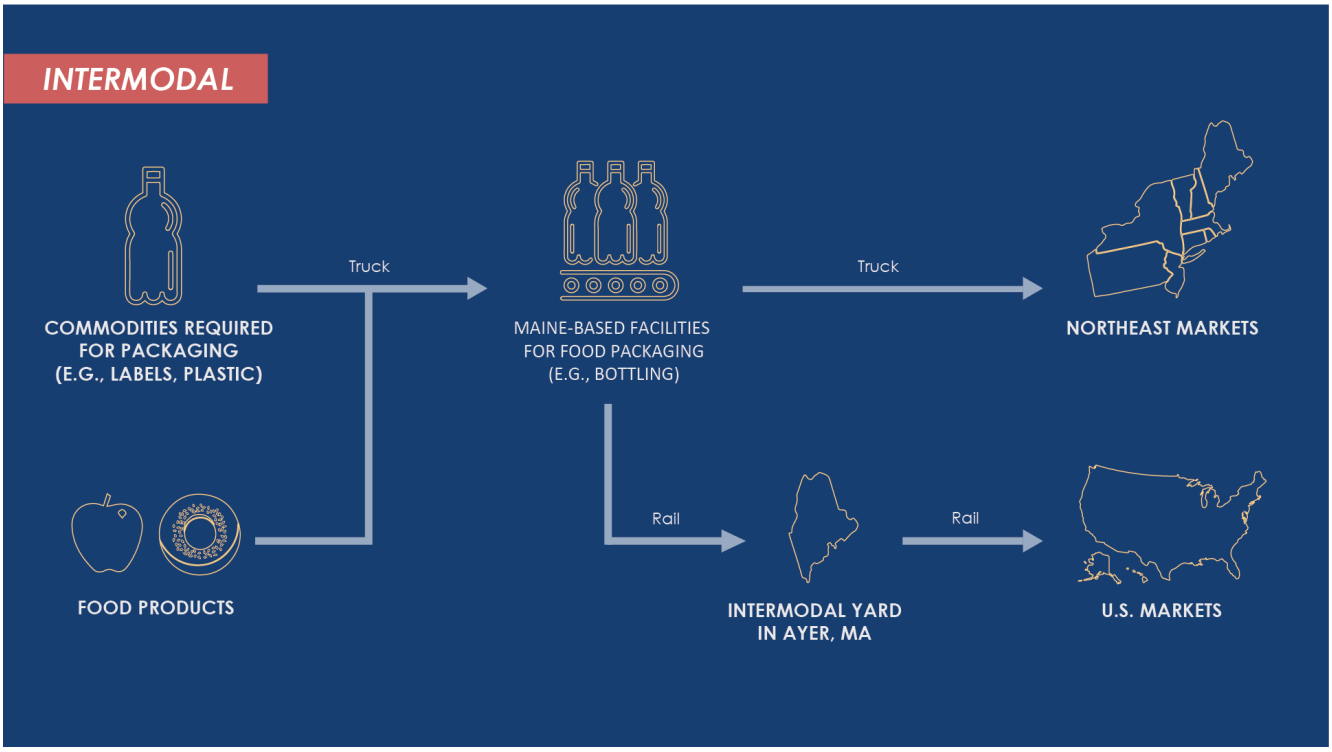
terminal was dependent on CN to provide access to the key markets that were of interest to Maine receivers. Interviewees reported interest in seeing this facility reactivated.

» **Presque Isle Intermodal Facility**: The intermodal facility was a public-private development, served by Montreal, Maine & Atlantic (now Maine Northern Railway) at Presque Isle. A small facility, it has handled outbound frozen French fries and various mulch materials sporadically. Special moves of equipment related to wind power systems have also been handled, but the facility is currently inactive. The lack of sufficient inbound commodities and the resulting high cost of positioning empty trailers and containers to load outbound products has made service operations unsustainable.

Supply Chain

Figure 3.36 illustrates how intermodal transportation can integrate into the supply chain for a product, in this case food products. Access to intermodal facilities allows shippers to access markets farther afield; by transferring product to an intermodal terminal to load onto rail, they are able to take advantage of the cost efficiencies of rail over trucking for longer distances.

Figure 3.36 Example Intermodal Supply Chain in Maine



4. FREIGHT RAIL SHIPPER DIVERSITY AND CONCENTRATION

Examining the distribution and concentration of users of rail freight illuminates trends in usage and helps to identify risks and opportunities. Diversity measures the balance and degree of concentration of rail traffic volumes among Maine rail users. A healthy and diverse rail user base is an indicator of rail system resiliency, enhances the significance of freight rail to the State's economy, and reduces risks for private and public stakeholders involved in the rail network. By examining this measure over time, use of the freight rail system and characteristics of the freight shippers can be better understood and inform potential policy actions.

The analysis was performed in the following manner:

- Using the STB Confidential Carload Waybill Sample, the number of freight rail customers in Maine were estimated for the years 2005, 2010, 2015, and 2017-2020. Customers were identified as inbound users (receiving freight by rail) or outbound users (shipping freight by rail). Industries receiving or shipping freight by rail with other industries within the state are also identified.
- Calculate an index to measure the freight rail shippers and market concentration, otherwise referred to as rail user diversity. The index is similar in approach to common economic concentration indexes (such as the Herfindahl index). The index combines the number of rail users with the concentration of rail shipment volumes and highlights how the rail customer user base has shifted over time.

4.1.1 Estimating Rail Customers

As rail customers are not revealed in the STB waybill data, a proxy for the number of rail users was developed. Identification of potential users was accomplished by using a combination of Freight Station Accounting Codes (FSAC) to identify the origin and destination of the waybills and two-digit Standard Transportation Commodity Classification (STCC) codes, as most rail customers typically handle a small number of distinct commodities. The estimation of rail users was approximated by the direction of rail traffic and the unique combinations of 2-digit STCC (STCC2) codes and FSACs. A single FSAC identifies a freight station that may

serve multiple shippers. Adding commodity identification at the 2-digit STCC level aids in identifying multiple shippers at a single FSAC. While a more granular commodity classification could potentially reveal additional shippers, the greater granularity substantially raises the risk of estimating more rail customers than are actually present at a particular station. Using unique combinations of 2-digit STCC codes with FSAC strikes a balance between commodities and freight stations that is appropriate for Maine rail users.[27,28]

The number of rail users by direction (*N*) was estimated for the rail users receiving goods in Maine or shipping goods from Maine. Intrastate traffic has Maine rail users at both ends of the rail shipment, and the shipper and receiver are identified individually. The estimated number of rail users by direction and year are shown in Table 4.1 and Figure 4.1.

Table 4.1 Number of Rail Users by Direction and Year

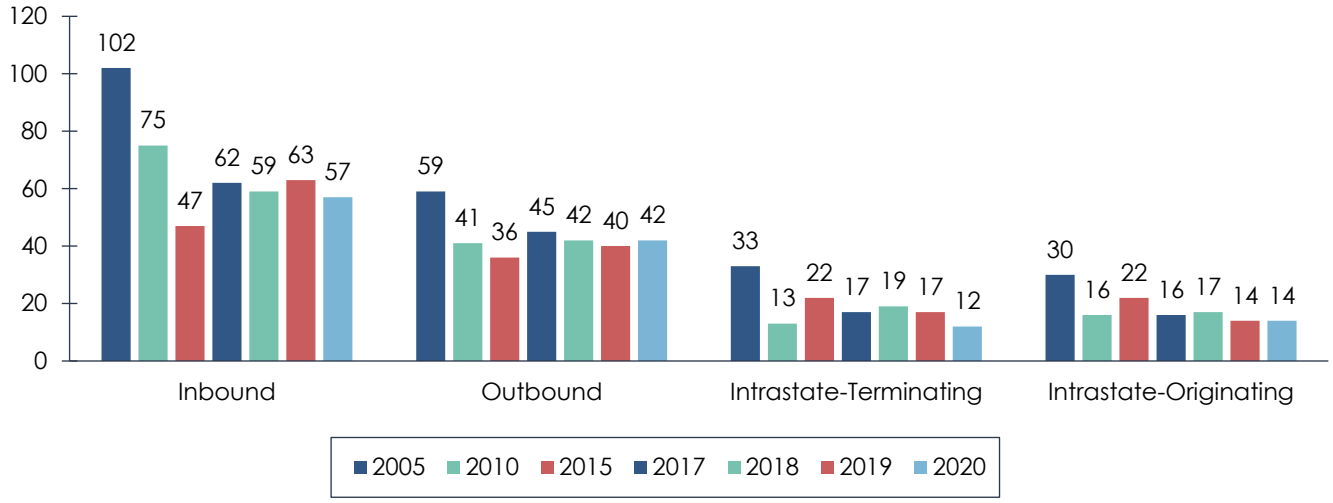
DIRECTION	2005	2010	2015	2017	2018	2019	2020	15-YR CHANGE	15-YR % CHANGE
Inbound (receiver)	102	75	47	62	59	63	57	-45	-44%
Outbound (shipper)	59	41	36	45	42	40	42	-17	-29%
Intrastate-Terminating (receiver)	33	13	22	17	19	17	12	-21	-64%
Intrastate-Originating (shipper)	30	16	22	16	17	14	14	-16	-53%

Source: STB Confidential Carload Waybill Sample, 2005, 2010, 2015, 2017-2020.

[27] United State Interstate Commerce Commission. "Interstate Commerce Commission Reports: Decisions of the Interstate Commerce Commission of the United States." U.S. Government Printing Office, 1987. Digitized Feb 25, 2013.

[28] U.S. FHWA. "Appendix C: Intermodal Transportation and Inventory Cost Model." Comprehensive Truck Size and Weight Limits Study - Modal Shift Comparative Analysis Technical Report. June 2015. https://ops.fhwa.dot.gov/freight/sw/map21tswstudy/technical_rpts/mscanalysis/app_c_cost_model.htm

Figure 4.1 Number of Rail Users by Direction and Year



Source: STB Confidential Waybill, 2005, 2010, 2015, 2017-2020.

Between 2005 and 2020, the number of inbound rail users decreased 44 percent and the number of outbound rail users decreased by 29 percent. Intrastate rail receivers declined 64 percent and intrastate shippers decreased 53 percent between 2005 and 2020, which indicates that Maine businesses shipping goods to other businesses in Maine and Maine businesses receiving products from other businesses in Maine have decreased nearly by half. Between 2005 and 2020, Maine shippers (Outbound and Intrastate-Originating rail users) have declined by more than a third and receivers (Inbound and Intrastate-Terminating rail users) have decreased by nearly half. The most significant decline in the number of shippers occurred between 2005 and 2010, coinciding with the 2008-2009 recession, and the shutdown of several paper mills. Some gains in the number of shippers were seen between 2010 and 2019, with some additional losses between 2019 and 2020.

4.1.2 Rail User Diversity

The index used to measure rail user diversity is simple in concept and provides insight within several contexts. In ecosystems, the index is called the Simpson index and is used to measure the diversity across a population. In economics, the index is called the Herfindahl–Hirschman index and is used to measure the proportion of market share across firms to identify monopolies. The rail user diversity index developed for this study measures the evenness of volumes shipped or received by rail users in Maine. After calculating the number of rail users

by direction and year (*N*), the index is calculated by squaring the sum of market share (s_i) for each rail user by direction and year.

Market share (s_i) is defined as the annual tons per rail user by direction, divided by the overall tons moved in that direction, as shown in the formula below:

$$Market\ share\ (s_i) = \frac{tons_{per\ rail\ user,\ \ by\ direction}}{total\ tons_{all\ rail\ users,\ \ by\ direction}}$$

The rail user diversity index formula is below:

$$Rail\ User\ Diversity\ Index\ (D) = \sum_{i=1}^{N} s_i^2$$

The rail user diversity index (D) ranges between zero and one. A low index indicates more diversity (less concentration), and a high index indicates low diversity (more concentration). The index can approach zero as the number of rail users (*N*) increases. The minimum for the index is always 1/*N* and the larger that *N* is, the closer the index is to zero, and as the index approaches zero the diversity improves.

A small rail user diversity index indicates a competitive industry without dominant rail users. A large rail user diversity index indicates a concentrated industry dominated by a small number of rail users. In general terms, the rail user diversity index results can be classified in the following categories:

- D below 0.01 indicates a highly competitive industry,
- D below 0.15 indicates an unconcentrated industry,
- D between 0.15 to 0.25 indicates moderate concentration,
- D above 0.25 indicates high concentration.[29]

The reciprocal diversity index provides a more basic understanding of diversity by indicating the equivalent number of equal-sized firms in the market. When firms have unequal shares, the reciprocal of the index indicates the "equivalent" number of rail users of equal volumes of traffic. The reciprocal diversity index formula is below.

[29] https://en.wikipedia.org/wiki/Herfindahl%E2%80%93Hirschman_Index#cite_note-5

$$Reciprocal\ Diversity\ Index = Equivalent\ Number\ of\ Equal\ Volume\ Rail\ Users = \frac{1}{D}$$

The reciprocal rail user diversity index provides a simpler perspective on the rail user diversity index by indicating the equivalent number of equal volume rail users in each direction. The results of the reciprocal diversity index by direction and year are shown in Table 4.2 and Figure 4.2. From this viewpoint, inbound rail users were consistently the most diversified throughout the years 2005 through 2020, but still nevertheless declining from 30 to 11 equivalent equal volume rail users, a drop of 35 percent.

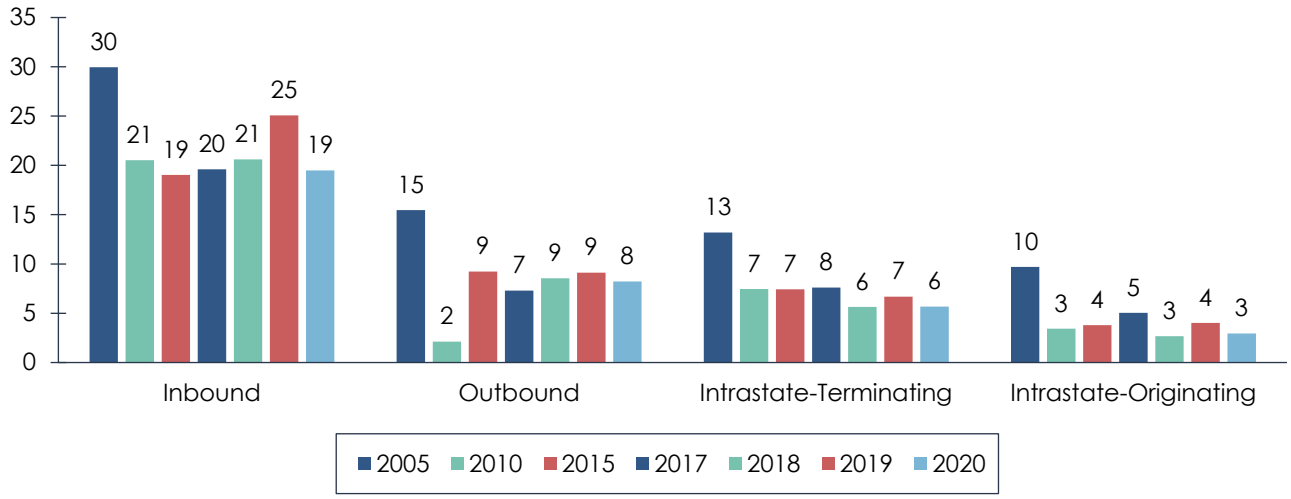
Each of the directions experienced a decrease to the equivalent number of equal volume rail users. The reciprocal diversity index also helps to demonstrate the sharp decline in diversity for outbound rail users in 2010. The anomaly in 2010 is related to a substantial increase in outbound volumes of lumber and wood products (STCC2 code 24) from a single FSAC. Between 2005 and 2010, the equivalent number of equal volume outbound rail users dropped from 15 to 2, and then rebounded to 9 in 2015. Between 2015 and 2020 the number of equivalent outbound rail users has remained steady.

Table 4.2 Reciprocal Diversity Index (Equivalent Number of Equal Volume Rail Users)

DIRECTION	2005	2010	2015	2017	2018	2019	2020	15-YR CHANGE	15-YR % CHANGE
Inbound (receiver)	30	21	19	20	21	25	19	-11	-35%
Outbound (shipper)	15	2	9	7	9	9	8	-7	-47%
Intrastate-Terminating (receiver)	13	7	7	8	6	7	6	-7	-57%
Intrastate-Originating (shipper)	10	3	4	5	3	4	3	-7	-70%

Source: STB Confidential Waybill, 2005, 2010, 2015, 2017-2020.

Figure 4.2 Reciprocal Diversity Index (Equivalent Number of Equal Volume Rail Users) by Direction and Year



Source: STB Confidential Waybill, 2005, 2010, 2015, 2017-2020.

Categorical results of the rail user diversity by year and direction are shown in Table 4.3. Over the period 2005 – 2020 rail user diversity has held steady for inbound and outbound traffic, but intrastate shippers shifted from unconcentrated to moderate concentration and intrastate receivers shifted from unconcentrated to highly concentrated.

Table 4.3 Rail User Diversity by Year and Direction

DIRECTION	2005	2010	2015	2017	2018	2019	2020
Inbound (receiver)							
Outbound (shipper)							
Intrastate-Originating (shipper)							
Intrastate-Terminating (receiver)							

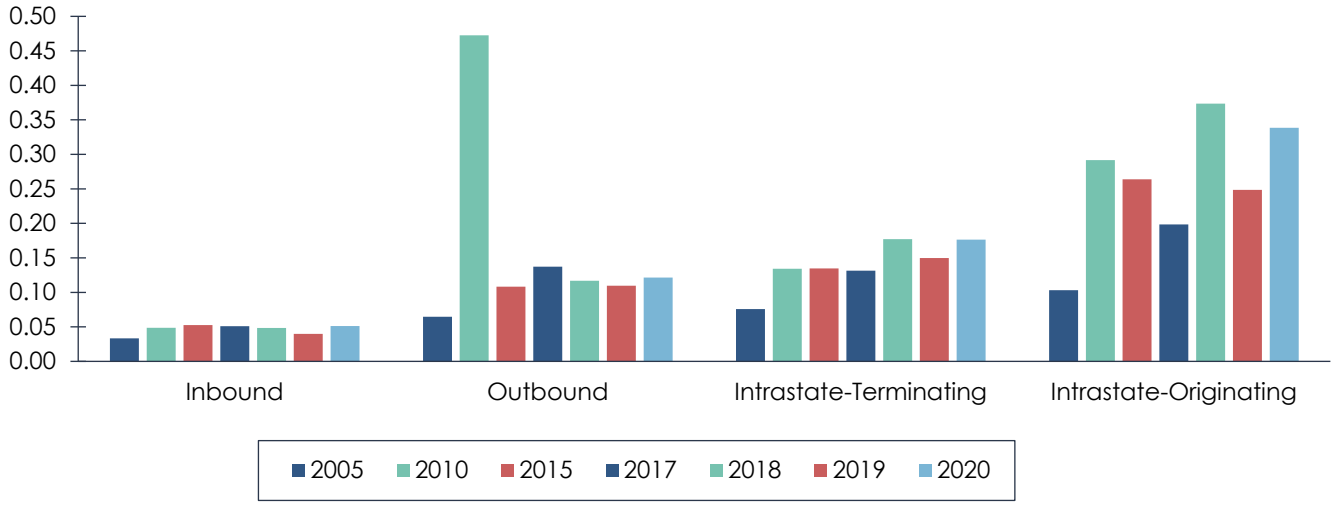
Source: STB Confidential Waybill, 2005, 2010, 2015, 2017-2020.

Note: Rail User Diversity Index Values:

- *Below 0.01 indicates a highly competitive and robust industry,*
- *Between 0.01 and 0.15 indicates an unconcentrated industry,*
- *Between 0.15 to 0.25 indicates moderate concentration,*
- *Above 0.25 indicates high concentration of rail use among a small number of users.*

The rail user diversity index by year and direction is shown in Figure 4.3 and Table 4.4.

Figure 4.3 Rail User Diversity Index by Year and Direction



Source: STB Confidential Waybill, 2005, 2010, 2015, 2017-2020.

Table 4.4 Rail User Diversity Index by Year and Direction

DIRECTION	2005	2010	2015	2017	2018	2019	2020	15-YR CHANGE	15-YR % CHANGE
Inbound (receiver)	0.03	0.05	0.05	0.05	0.05	0.04	0.05	0.02	54%
Outbound (shipper)	0.06	0.47	0.11	0.14	0.12	0.11	0.12	0.06	88%
Intrastate-Terminating (receiver)	0.08	0.13	0.13	0.13	0.18	0.15	0.18	0.10	133%
Intrastate-Originating (shipper)	0.10	0.29	0.26	0.20	0.37	0.25	0.34	0.24	228%

Source: STB Confidential Waybill, 2005, 2010, 2015, 2017-2020.

Note: Rail User Diversity Index Values:

- *Below 0.01 indicates a highly competitive and robust industry,*
- *Between 0.01 and 0.15 indicates an unconcentrated industry,*
- *Between 0.15 to 0.25 indicates moderate concentration,*
- *Above 0.25 indicates high concentration of rail use among a small number of users.*

Key observations of the balance of rail traffic between rail users include:

- Inbound traffic is unconcentrated among rail users and exhibits more shipper diversity than rail traffic moving in other directions. Between 2005 and 2020, the number of inbound users decreased from 102 to 57 (44 percent decline), the number of equivalent users decreased from 30 to 19 (35 percent decline), and the diversity index deteriorated from 0.03 to 0.05 (54 percent increase). The overall diversity remained rather equally proportioned. These results indicate **inbound rail market is unconcentrated and remained as such despite a loss in number of shippers.**

- Outbound traffic is unconcentrated among rail users and the number of shippers declined the least between 2005 and 2020. There was an anomaly in 2010 with a substantial decrease in diversity for outbound traffic due to a dramatic surge in lumber and wood volumes shipped from a single FSAC in 2010. Between 2005 and 2020, the number of outbound users decreased from 59 to 42 (29 percent decline), the number of equivalent users decreased from 15 to 8 (47 percent decline), and the diversity index deteriorated from 0.06 to 0.12 (88 percent increase). The overall diversity remained rather equally proportioned. **Despite a decline in diversity, the outbound rail market remains unconcentrated.**
- Intrastate receiver traffic exhibits the least diversity, with fewer rail users contributing to rail flows. Intrastate traffic is moderately concentrated for the receivers and highly concentrated for the shippers. Between 2005 and 2020, the number of intrastate receivers decreased from 33 to 12 (64 percent decline), the number of equivalent users decreased from 13 to 6 (57 percent decline), and the diversity index deteriorated from 0.08 to 0.18 (133 percent increase). The overall diversity remained rather equally proportioned. **The number of rail users receiving traffic from other in-state users declined significantly and the proportions between the rail users became less equal—the intrastate receivers dropped from an unconcentrated to moderately concentrated market.**
- Intrastate shipper diversity had the greatest decrease. Between 2005 and 2020, the number of intrastate shippers decreased from 30 to 14 (53 percent decline), the number of equivalent users decreased from 10 to 3 (70 percent decline), and the diversity index deteriorated from 0.10 to 0.34 (228 percent increase). The overall diversity remained rather equally proportioned. **The decreased number of rail users shipping goods to other in-state users impacted the diversity.**

In summary, rail traffic moving in all directions (inbound, outbound, and intrastate) experienced a decline in freight rail users, a deterioration in rail user diversity, and an increase in market concentration between 2005 and 2020.

5. TRENDS AND COMPETITIVE FACTORS AFFECTING RAIL

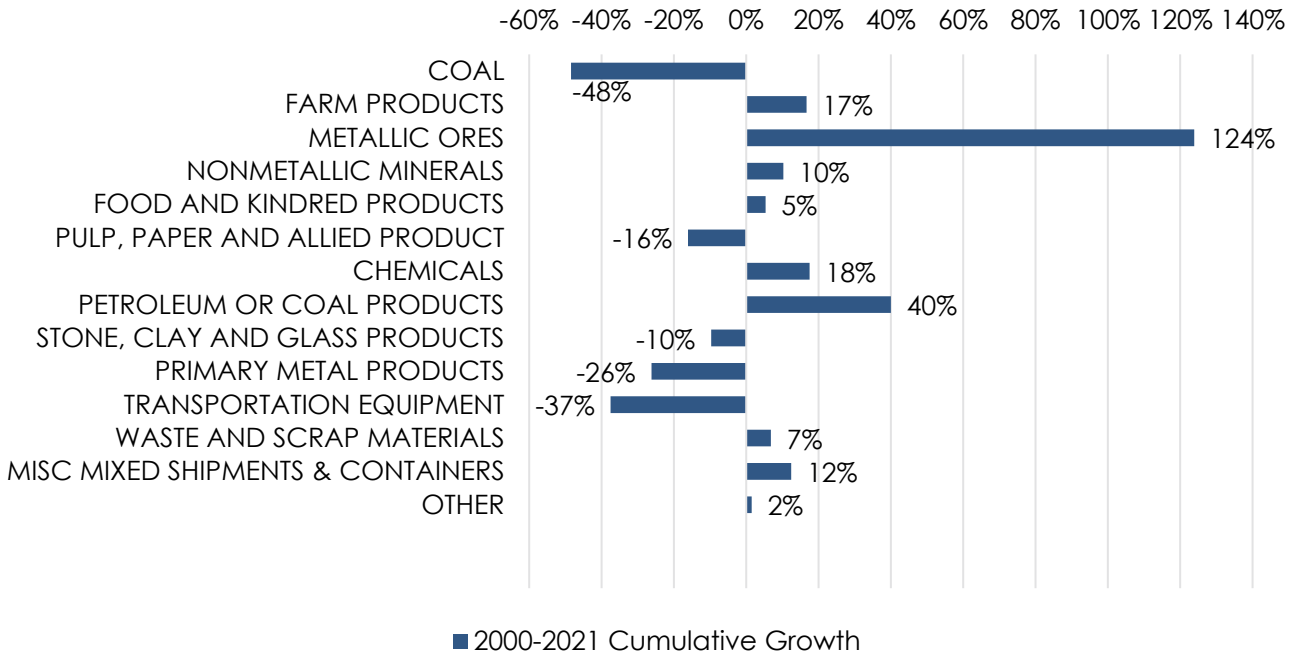
This section examines trends and recent developments that have the potential to impact Maine's rail system in the coming years, including changes in the organization of the freight rail sector, big-picture changes for freight and goods movement, developments in labor markets, updates to the rail regulatory environment, new technological developments, and the impact of COVID-19 on the demand for intercity passenger rail travel.

5.1 Freight Rail Industry Performance

Over the past decade, the financial performance of the Class I railways has reached new heights amidst declining traffic volumes. Between 2014 and 2021, unit volumes dropped an average of 1.1% per year, while tonnage declined an average of 2.5% per year, as a result of the ongoing shift from carload to intermodal. This decline has been heavily driven by changes in the industrial sectors that have been most reliant on rail service. Compounding these shifts have been deteriorating operational performance due to labor shortages, supply-chain volatility, and reduced resilience resulting from strategies – commonly referred to as Precision Scheduled Railroading or "PSR" - that the Class I railroads have broadly implemented since 2015 to more closely align capacity with demand.

As a result of the COVID-19 pandemic, between 2019 and 2020 rail freight tonnage fell by 11 percent while carload volumes fell by 7 percent. The commodities most negatively impacted included coal, nonmetallic minerals, primary metal products, and mixed shipments and containers. The only commodities to see an increase in tonnage were farm products and food/kindred products. Subsequently, 2021 saw an increase in both tonnage (6 percent growth) and carload volumes (5 percent growth) over 2020, although both were still shy of pre-pandemic levels. As of mid-2022, carload traffic remained stagnant, with trends varying considerably across the major commodities. Intermodal traffic has declined versus 2021 volumes, principally because of service issues and capacity constraints described previously.

Figure 5.1 Cumulative Growth in Class I Rail Traffic Tonnage by Commodity, 2000-2021



Source: Association of American Railroads Commodity Statistics.

Looking ahead, the prospects for rail traffic growth are cloudy. The FAF5 forecast (developed using Q2 2021 as the basis) anticipates national freight rail traffic volumes to grow at an annual rate of 0.15 percent between 2017 and 2030, on expectations of overall freight traffic growth across all modes of approximately 0.91 percent annually. Most freight traffic growth would accrue to highway. Notably the projected growth rate for freight traffic for all modes substantially trails GDP growth through 2030, a result of the continued shift away from goods production in the U.S. economy and low population growth.[30] This is a change from the recent past when freight traffic grew at rates only modestly lower than GDP. Furthermore, this slow growth is a precursor to a highly competitive freight transportation marketplace, making the situation for the rail industry more challenging.

Overshadowing all other rail freight markets has been the decline in coal, which has long been not only the single largest commodity handled by rail, but also the highest revenue generator (see Figure 5.1). Coal demand for electricity generation has dropped since 2008 when volumes peaked at 7.7 million carloads originated. By 2016, just 3.7 million carloads of

[30] https://data.bts.gov/stories/s/Freight-Transportation-the-Economy/6ix2-c8dn.

coal were originated by rail, less than half of that of 2008. Demand for coal mining then declined at an annualized rate of 6.7% from 2016 to 2021. In 2021, carloads of coal originated dropped to 3.3 million, but coal still accounted for 27% of originated tonnage for U.S. railroads, a larger share than any other commodity. From a revenue standpoint, coal stood in third place behind intermodal and chemicals, accounting for 11% of Class I freight revenues.

In addition to coal, other top carload markets for railroads include chemicals, motor vehicles, and grain and farm products. Chemicals, stood in third place behind coal and intermodal for Class I Railroads in terms of both carloads originated and gross revenue as of 2015. By 2021, the transportation of chemicals supplanted coal as the second largest source of rail freight revenue. While chemical revenues have grown, the sector has not provided much volume growth for the railroads; from 2016 to 2021, Class I railroad traffic from chemicals grew only 0.2% each year, following a lengthy period of solid volume growth.

These trends have directly and indirectly affected rail volumes in Maine, which has largely been a carload market. While there clearly are growth opportunities in the carload sector – particularly in chemicals, construction materials, and agricultural products - much of the industrywide focus is on intermodal traffic. With the railroad industry having developed during the period of heavy industrialization during the 19th and early 20th centuries, its customer base has skewed towards sectors that are mature. However, the ongoing evolution of the US and global economies has shifted the economic center away from these heavy industries towards smaller and lighter, higher value goods, manufactured and distributed over a broad geographic area that does not lend itself well to traditional rail carload services. Rail intermodal service has allowed the rail industry to gain some of this traffic. This trend accelerated during the 1980s as supply chains became increasingly global, facilitated by the ability to readily transition shipments between modes through the widescale containerization of freight. By 2019, railroads handled approximately 18 million containers and trailers. FAF5 forecast projects growth through 2030 to be robust, on the order of 28 percent overall on a tonnage basis. However, the potential is considerably greater.

During the international trade boom, the rail industry focused its efforts on capturing long-haul port to major inland market traffic, and with considerable success. In key West Coast to Midwest lanes rail has become the dominant mode. In the East, with hauls being considerably shorter and thus more competitive with highway, railroads have been less successful in achieving large market shares. Nevertheless, taking into account the national

size of the dry van and reefer truckload market for hauls of 500 miles or more (i.e. distances involving more than one day's drive where intermodal becomes competitive with highway), railroads held little more than a 10% market share in 2019 of roughly 88 million units. This leaves a substantial market for railroads to pursue.[31] Tapping into this market will require capital investment and adoption of market-responsive pricing and service strategies.

5.2 Current Issues in the Railway Sector

5.2.1 Precision Scheduled Railroading (PSR)

Precision Schedule Railroading (PSR) is a set of strategies intended to improve financial performance by maximizing revenues and generating cost savings through improved operational efficiency and asset utilization. Central elements include the following: [32]

- Shifting traffic from hub-and-spoke operations (which rely on freight yards) to direct origin-destination movements (which eliminate the need for intermediate yarding) with the goal of speeding deliveries, reducing car handling, and reducing terminal dwell times.
- Regular train departures and balancing of traffic flows to improve asset utilization and operational consistency.
- Operating "general purpose" trains instead of dedicated services where possible.
- Maximizing train lengths and minimizing locomotive requirements.
- Maximizing revenue yields by incentivizing shippers to adapt their operations to minimize railroad costs, along with abandoning less efficient services and routes.

Following demonstrated financial success at Canadian railroads CN and CP in the early 2010's, Wall Street investors pressured all but one of North America's seven Class I railroads to publicly adopt PSR since 2015. With a vision of streamlining operations, railroads cut employment and idled infrastructure and rolling stock assets that were no longer needed because of improved efficiencies and reduced volumes. This has resulted in substantial

[31] Blaze, Jim. "Rail Freight: What's in the Crystal Ball?" Railway Age, February 7, 2022. https://www.railwayage.com/freight-forecasting/rail-freight-whats-in-the-crystal-ball/.

[32] Barrow, Keith. 2019. "Precision Scheduled Railroading - Evolution or Revolution?" International Railway Journal, September 17, 2019. https://www.railjournal.com/in_depth/precision-scheduled-railroading-evolution-revolution/.

impacts on the Class I railroad workforce. In 2019, more than 20,000 rail workers in the U.S. lost their jobs, followed by another 18,900 in 2020[33].

Markedly improved financial performance has been the result across the board, and rail industry profitability has reached record highs in recent years, even with the recent disruptions caused by COVID-19 and the ensuing stresses on supply chains and freight logistics. Proponents argue that PSR railroads are more resilient in responding to service interruptions, operational performance has produced measurable service benefits for shippers, and the cost savings allow railroads to pursue business that would otherwise not be financially viable. However, there is scant evidence that shippers are realizing service improvements on anywhere near a consistent basis, and there is little documented record of railroads gaining new business as a result of PSR adoption. This has been the case both with recent adoptees of PSR, such as CSX and Norfolk Southern, as well as the railroad that first implemented PSR, CN, which suffered an extended period of service failures due to insufficient physical assets and personnel during the 2010's. Furthermore, the poor rail system performance since the start of the COVID-19 pandemic, and the resulting severe labor shortage, has in part been attributed to the lean practices associated with PSR.[34]

Shippers have complained that PSR has forced them to reorganize their operations to receive and dispatch cars outside normal business hours or different days. Some have reported receiving large volumes of cars at irregular intervals, more than they are capable of handling at a given time and exceeding their capacity for timely loading or unloading. This result can expose shippers to incurring substantial demurrage charges when they are unable to handle the cars in a timely manner[35].

One of the more controversial elements of PSR has been the operation of trains that are far longer than was previously standard practice. Longer trains – typically in excess of 10,000 feet in length vs. 7,000 feet that had been common practice - allow more freight to be moved by fewer crews, improving labor productivity and reducing operating costs. The distribution of locomotive power can provide for the safe handling of longer trains through

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[33] Employment in rail transportation heads downhill between November 2018 and December 2020, Monthly Labor Review, US Bureau of Labor Statistics, October 2021, https://www.bls.gov/opub/mlr/2021/article/employment-in-rail-transportation-heads-downhill-between-november-2018-and-december-2020.htm.

[34] Blaze, Jim, "Clear Evidence: Near-Zero PSR Service Improvements", May 20, 2022. https://www.railwayage.com/freight/class-i/clear-evidence-near-zero-psr-service-improvements/?RAchannel=home

[35] Barrow, 2019.

improved braking and mitigation of in-train forces that raise the risk of derailments. While long trains can function well with high volume bulk and container trains, their suitability for service sensitive operations is debatable. Long trains take longer to build and break down, and their immense length can complicate and slow down operations in terminals as well as along main lines.

It will be some time before the full impact of PSR becomes evident, specifically whether Class I railroads can sustain their financial performance while maintaining assets and service quality at a sufficiently competitive level. To a substantial degree, whether PSR becomes central to the long-term success of the rail industry or just another buzzword in a long parade of management fads will depend to a large degree on their willingness to adapt operating and commercial strategies to meet market needs.

5.2.2 Merger Activities

In addition to the recent acquisitions by Canadian Pacific (CP) of the Central Maine and Quebec Railroad (CMQR) and CSX of Pan Am Railways (PAR), which are both discussed in the Rail System Existing Physical Conditions Profile Technical Memorandum, there is one significant pending Class I transaction, which is detailed below.

Proposed Acquisition by CP of Kansas City Southern (KCS)

CP and KCS in September 2021 agreed to combine and form Canadian Pacific Kansas City (CPKC), the first U.S.-Mexico-Canada rail network. STB in November 2021 accepted for consideration their application, and as part of the review process, the Office of Environmental Analysis is assessing CPKC's potential effects on the environment. Since the filing, four Class I railways, CN, UP, NS, and CSX, have announced joint opposition to the proposed merger, contesting that the Surface Transportation Board must first place conditions on CP that would ensure shipper competition.

At least one Maine shipper has weighed in with a letter of support for the CPKC merger in a letter to the STB. Pleasant River Lumber in Foxcroft-Dover, which ships approximately 325 cars per yar from two sawmills on the Canadian Pacific, expressed their approval of the merger. According to their Industrial Sales manager, "the combined CPKC network – with single-line hauls and access to premier ports on the U.S. Gulf, Atlantic and Pacific coasts as well as to

key overseas markets – would help us reach our existing markets and new markets more efficiently."[36]

5.2.3 Truck and Rail Labor Shortage

Labor shortages are being felt in the railway and trucking sectors (and more broadly in all of transportation and logistics) as companies struggle to find enough qualified employees for driving trucks and operating trains to both accommodate growth and renew a rapidly aging workforce. Licensing requirements that require drug tests and criminal background checks greatly reduces the traditional pool of labor that has worked in the transportation industry. In trucking, productivity is further challenged by electronic log devices that enforce hours of service regulations.

As of 2021, the American Trucking Association (ATA) estimated that the trucking industry had reached a historic truck shortage of nearly 85,000 drivers.[37] One reason for the shortage relates to the age of the current truck driver workforce. The median age of an over-the-road truck driver was 49 years, which is significantly higher than the median age of all U.S. workers, which stood at 42 years. The trucking industry has also struggled to recruit women, with just just seven percent of U.S. truck driver population. The COVID-19 pandemic also caused some drivers to leave the industry and slowed down driver training schools, especially during 2020. At current trends, the truck driver shortage could surpass 160,000 in 2030.

Railroads are also experiencing severe labor shortages for similar issues of workforce retirements, and barriers to bringing in new employees, particularly in operations. Quality of life issues loom large, as irregular hours, lengthy time away from home, drug testing, and other safety requirements such as background checks discourage traditional sources of employees for these functions.

5.2.4 Positive Train Control

Positive Train Control (PTC) is a federally mandated railroad safety improvement that all passenger railroads and Class I freight railroads must implement. PTC is a communication-

[36] https://railsandports.com/2021/03/cp-kcs-acquisition-gains-support-from-maine-customer/

[37] "Driver Shortage Report 2021." Arlington, VA: American Trucking Association, October 25, 2021. https://www.trucking.org/sites/default/files/2021-10/ATA%20Driver%20Shortage%20Report%202021%20Executive%20Summary.FINAL .pdf.

based / processor-based train control technology that provides a system capable of reliably and functionally preventing train-to-train collisions, over-speed derailments, incursions into established work zone limits, and the movement of a train through a main line switch in the improper position. Lines requiring PTC include Class I railroad main lines that handle any poisonous-inhalation-hazardous materials and any railroad main lines over which regularly scheduled intercity passenger or commuter rail services are provided. Also, Class I main lines that exceed 5 million gross tons per year are subject to the PTC statute, even if no passenger rail service is operated or poisonous/hazardous materials traffic is carried.

RSIA mandated that PTC be implemented across the vast majority of the primary rail network by December 31, 2015. In late 2015, the deadline was extended to the end of 2018, with the possibility for 2 additional years if certain requirements are met. The December, 2020 final deadline for activation of PTC on mandated routes was met by all rail operators.

PTC implementation has the potential to transform future main line operations. While the PTC mandate was driven by safety concerns, the railroad industry has begun to acknowledge its utility as the foundation for future improvements in operating efficiency and train performance. This "Version 2" of PTC – the deployment of which will take place in the 2020s – is likely to bring extensive change to railroading, first, through greatly improved monitoring and control of trains, and eventually the automation of train operations. These improvements will permit the reduction of crew size in freight road trains, and potentially automatic operation. For railroads, automatic train operation is a far simpler technological challenge than its if for highway vehicles. For railroads to remain competitive once autonomous trucks become commonplace, the productivity gains brought by these technologies will be imperative to their survival.

PTC has not yet been installed on any trackage in Maine. This includes the former Pan Am Railways (now CSX) route utilized by the Downeaster passenger service, between Brunswick, Portland and Boston. However, installation of PTC on this route has been funded through a federal appropriation to Amtrak and is anticipated for completion by 2024.

5.2.5 Autonomous Trucks and Automated Trains

Autonomous Trucking

Forecasts of increasing trucking volumes, a truck driver labor shortage, and more stringent hours-of-service regulation are three main spurs leading to investment in autonomous trucks (Ats). AT technology continues to develop, promising a means to satisfy a growing demand while reducing costs at the same time.

All of the major global vehicle manufacturers are engaged in the development of autonomous trucks. Given the economic incentives available to improving freight hauling productivity, adoption is expected to outpace that of passenger vehicles. More than 50 companies are engaged in testing various technology schemes for autonomous trucking. Systems in testing phases today automate the freeway portion of a truck's journey while requiring a driver to manually navigate the complexities of local roads. The current level of technology is sufficient to allow for the implementation of platooning—where as many as three trucks can be operated effectively as one unit—as well as the deployment of autonomous trucks in captive situations, such as logistics centers, ports, and intermodal terminals.

The timing of the commercial deployment of fully autonomous operation in public environments has been a moving target. TuSimple has tested AV trucks on a 1,000-mile route between Dallas and Phoenix, and has announced plans to expand across the U.S. by 2024. Substantial technical hurdles remain to be overcome—particularly achieving safe and reliable operations in mixed traffic, handling irregular or unexpected incidents, weather, instilling confidence in the safety and reliability of autonomous trucks in the minds of the industry and the public, and inconsistent state-level regulations.

AT could be both a benefit and a challenge to railways. Lower labor costs could make trucking more cost competitive, allowing it to divert more service-sensitive traffic from railroads in mid- to long hauls. However, railroads could respond with similar technological advances, such as reducing the train crew size from two to one or, eventually, fully automatic operation once PTC has been fully deployed, a simpler problem to solve on the railway than on the highway. AT could also complement the railroad industry, which could use the technology to operate trucks in rail yards and intermodal yards, as well as ports and other industrial sites.

The implications of AT to freight railroads may be existential in that AT can erode the key competitive advantage trains have over trucks today. Shipping by train tends to be less expensive than by truck over longer distances. An oft-quoted rule of thumb is that for trips of 500 miles or greater, trains are more competitive than trucks. The main culprit driving higher trucking costs is labor, followed by fuel; marginal trucking costs of labor and fuel were 43 and 22%, respectively, in 2017.

With the advent of AT, however, the cost advantage of trains will be reduced. Once the ultimate goal of reliable and safe operation over the roadway network without any human involvement has been achieved, the potential cost savings are substantial – a 2020 report found that driverless trucks could produce total cost savings of 30-45 percent depending on truck configuration. While the degree to which these cost savings can be broadly achieved is unclear, it is evident that even partial adoption will greatly increase the economic competitiveness of truck with rail for longer hauls. Consequently, shippers may choose driverless trucks for their loads instead of trains. Intermodal traffic, which requires a truck haul to and from the rail intermodal facility, is perhaps the most vulnerable to diversion. That is, the load could simply skip the rail haul and keep moving by truck. Heavy bulk traffic like grain and coal, which might originate with a rail move, is a less attractive target for an AT diversion.

With AT moving forward, railroads must develop strategies to cope with a potential diversion of traffic from rail to truck, as shippers seek to exploit all the advantages that AT can deliver. While one strategy might integrate AT with a rail operation, another might be a response in kind, as described in the following section.

Automated Train Operations

Trains without locomotive engineers are a proven technology. Subway and other fixed guideway passenger and freight transport systems have operated automatically since the 1960's, and remote-control locomotives have been commonly used by railroads since the 1980s. In specific areas, such as yards, a locomotive engineer may control a remote-control locomotive from a waistband pack. This allows a locomotive engineer to control a train from outside the cab, thus offering the potential for increased productivity and lower staffing levels. If the locomotive loses communications with the remote control, it stops automatically. Being able to operate the train from outside the cab improves the operational efficiency of working within a yard. It is unlikely that future yard operations can be fully automated due to

the physical work that it takes to build and operate trains (e.g., throwing manual switches, attaching air hoses, and engaging hand brakes).

More recently, train automation technology has been deployed on freight main lines. Rio Tinto Mining in Western Australia runs an increasing number of driverless trains on its 1,100-mile rail network. In the US, the railroads' investment in PTC established a foundation for greater levels of automation that can reduce staffing levels on line-haul freight trains (see previous discussion on PTC). The prospect of greater automation unnerves rail labor due to potential elimination of jobs.[38]

The technology being developed for automating freight trains will also be applicable to passenger operations, with the prospect of some cost savings, but less than for freight. With these services generally having operating costs greater than fare revenue, there is an opportunity to reduce required operating subsidies and/or providing increased service levels.

5.2.6 Electrification

North America's transportation system is almost entirely reliant on the combustion of fossil fuels, with diesel engines being the dominant technology used for freight haulage by rail, highway, and water. Although the emissions from diesel-powered engines have been reduced substantially in recent decades, they continue to be a major source of several criteria pollutants and greenhouse gases. A central challenge facing the rail industry is how to successfully transition their fleet to low- or no-GHG alternative sources of propulsion energy. This migration presents a critical opportunity to impact climate change, improve air quality and, potentially, spin off other categories of public benefits.

Electrification offers the prospect of significant cost savings to the trucking industry, savings that will need to be countered by similar technological advancement in the rail industry to maintain its competitive position. For trucking, overall savings on the order 10-25 percent are expected by the mid-2020s, and these are expected to improve as capital costs decline.[39]

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[38] https://fortune.com/2019/07/29/autonomous-trains-challenges/

[39] Why Regional and Long-Haul Trucks are Primed for Electrification Now. https://eta-publications.lbl.gov/publications/why-regional-and-long-haul-trucks-are
International Council on Clean Transportation, *How much does an electric semi really cost?* https://theicct.org/cost-electric-semi-feb22/. Published analyses generally do not take into account changes in lading capacity resulting from battery weight for Class 8 trucks, which can impact the overall economics of a battery-powered truck, particularly for the type of bulk freight that is commonly transported by rail.

Offsetting these benefits to some degree is the higher weight of the electric highway tractor, which may reduce the maximum freight capacity that can be transported; however, truck manufacturers are pushing to increase weight allowances so as to offset capacity losses.

Figure 5.2 Volvo VNR battery powered truck presently has a range of up to 275 miles

For highway applications, both battery as well as fuel cell (hydrogen-powered) options are actively being developed. However, battery technology, driven by the large global passenger car market, is advancing more rapidly. Battery-powered trucks suitable for short-haul use are currently available, and longer-range Class 8 trucks that compete more directly with freight rail are entering commercial production using either battery or fuel cell technology. The market is highly competitive, with all of the major global truck manufacturers, along with new entrants such as Nikola and Tesla, pursuing development of trucks with ranges of 500 miles or more.

For rail, an obvious approach to electric operation is the installation of overhead catenary, as is done along the Northeast Corridor between Boston and Washington. A proven solution to achieving zero GHG emissions, the capital cost hurdles to doing so are extremely high. Thus, the North American focus is on technologies that are less capital intensive by minimizing major infrastructure investment and leveraging off technological developments in other sectors. Trials have been launched with both battery-powered and hydrogen technologies on freight and passenger rail rolling stock in North America and overseas. Some examples are as follows:

» In 2021, Wabtec, together BNSF and the California Air Resources Board trialed a 2.5 MW battery storage line-haul locomotive.[40] Since then, Wabtec has continued to develop the

[40] https://www.railwayage.com/mechanical/locomotives/bnsf-wabtec-bel-pilot-the-results-are-in/

technology, and has announced versions with higher capacity batteries that have been sold to North American and overseas railroads for evaluation purposes.[41]

- Also in 2021, CP, in collaboration with Ballard, a leading producer of hydrogen fuel cells, announced the development of a main line locomotive using this technology.[42]
- In January 2022, Union Pacific Railroad (UP) announced the acquisition of 10 battery electric locomotives each from Wabtec and Progress Rail. Intended for switching cars in yards and terminals, this is the largest procurement of battery-electric locomotives by a freight railroad to date.[43]
- Amtrak *Airo* Intercity Trainsets, which are being produced by Siemens Mobility, will include a version that allows for short-range operations using battery power. These battery-powered trainsets will be deployed on the Empire Corridor between New York and Albany, where diesel operation is precluded when operating into and out of Penn Station, New York.[44] Initial deliveries of the battery-powered variant are anticipated to occur in 2025.[45]
- In California, the San Bernardino County Transportation Authority (SBCTA) contracted with Stadler, a railcar manufacturer headquartered in Switzerland, to utilize hybrid fuel cell and battery technology in a multiple-unit regional passenger train. Presently being tested in Europe, the first trains for the US market are scheduled for delivery to SBCTA in 2024. If successful, Caltrans anticipates deploying similar trains in other regions of the state. [46]

Development of alternative technologies to diesel engines in rail has lagged highway developments. This is due to the much smaller market for railroad locomotives than for highway trucks, the inherent energy efficiency advantages of rail over highway, the far longer longevity of the rolling stock (locomotives typically are in active use for 40 or more

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[41] https://www.goerie.com/story/business/2021/11/12/wabtecs-flxdrive-built-erie-run-bessemer-lake-erie-railroad/6359831001/

[42] https://www.globalrailwayreview.com/news/119246/cp-fuel-cell-modules-hydrogen-locomotive-program/

[43] https://www.up.com/media/releases/battery-electric-locomotive-nr-220128.htm

[44] https://www.railwayage.com/passenger/intercity/from-siemens-amtraks-next-gen-trainsets/

[45]The *Downeaster* utilizes Amtrak's national rolling stock pool and will be receiving the new *Airo* trainsets in the mid to late-2020s. The Diesel-powered version will be deployed on the *Downeaster;* while it may be possible for the Downeaster to migrate more rapidly to zero emissions technology, it would come with substantial additional capital and ongoing operating costs.,

[46] https://www.gosbcta.com/project/diesel-multiple-unit-to-zero-emission-multiple-unit-pilot/

years), and far higher energy requirements of a mainline locomotive versus a diesel highway tractor. This raises technical challenges that will need to be addressed before widespread adoption can occur, a burden that the rail supply industry may not be able to absorb on its own. While many of the large Class I railroads have committed to migrating away from conventional diesel-electric locomotives for future fleet acquisitions, implementation at smaller railroads, including those operating in Maine is expected to lag due to the cost and initial complexities associated with their deployment.[47]

Key challenges to widespread adoption of alternative propulsion technologies in the railroad industry include sufficient availability of the alternative fuel(s), and the cost of ownership. Cost components include the cost to acquire the vehicle, fuel costs, availability (including range, fueling time, and out-of-service time associated with maintenance), longevity, and any additional maintenance costs. The net cost of ownership also accounts for any incentives offered by federal or state governments.

5.2.7 Shipment Visibility

Rail lags other freight modes in providing shipment visibility, which has increased in importance as customers increasingly require the ability to track shipment progress in real-time from the time that the goods are tendered for shipment to when they are delivered. While technology for intermittent tracking of rail shipments has been available for decades through industry data clearinghouse Railinc, for railroads to remain competitive, access to real-time shipment status and schedules has become increasingly necessary.

Since 2020, several early-stage rail shipment visibility applications that go beyond capturing and analyzing Railinc car location messages have emerged:

- RailPulse is a recently-formed joint venture between PennDOT, Norfolk Southern, Genesee & Wyoming, Watco Transportation Services, and other North American rail companies to create a new technology platform with the premise of continuous visibility into carload shipments. RailPulse will utilize a satellite-based communications system to link GPS and sensors installed on participating railcars to feed a platform developed by Railinc. RailPulse will provide real-time information on individual railcar

[47] Railway Age, Zero-Emission Locomotives on U.S. Railways? (February 12, 2021). https://www.railwayage.com/mechanical/zero-emission-locomotives-on-u-s-railways/?RAchannel=home and https://www.trains.com/trn/union-pacific-sees-battery-electric-locomotives-as-the-future/

movements, including location, lading and equipment condition (such as hand-brake status, temperature, empty/load, etc.) to users, including shippers, car owners, and railroads. A particular benefit will be visibility into first and last mile service, the process whereby railcars are picked up and delivered at industry sidings. The technology is expected to enter the trial stage in 2023, with a commercial rollout commencing in 2024. RailPulse was awarded a federal Consolidated Rail Infrastructure and Safety Improvements (CRISI) grant in the fall of 2020, [48]

- In early 2022, Blume Global, a supply chain technology solutions company, announced the development of a complimentary, cloud-native platform that allows companies that utilize railroad intermodal services to better coordinate cross-country freight deliveries, in partnership with UP, Norfolk Southern and CSX.

5.3 Economic and Regulatory Trends

Railways were the first industry subject to economic regulation by the federal government, starting with the passage of the Interstate Commerce Act of 1887. By the 1970s, a discriminatory regulatory regime helped to drive the privately owned railroads to the brink of ruin. The Stagger's Rail Act of 1980 was key to the survival of railroads in the U.S. because it greatly reduced economic regulation of the industry, allowing the railroads flexibility in setting prices, entering and exiting markets, and restructuring ownership of the network. Railroad regulation is constantly evolving, reflecting rail industry performance, shipper concerns, and the general political climate. This section highlights key current issues and proceedings that are relevant to Maine.

5.3.1 Reciprocal Switching

Reciprocal switching would allow shippers that are only served by one railroad to arrange for their cars to be transferred (or switched) to a different railroad at a nearby junction point. The intent is to provide competitive options among railroads for line-haul service. In July 2016, the STB issued a finding proposing Reciprocal Switching as a new rule (Ex Parte 711). The proposed rule made it possible for shippers to obtain reciprocal switching under certain

[48] Ralpulse, The Power of Collaboration, https://www.railpulse.com/news-updates/the-power-of-collaboration/ RailPulse Teams With Railinc, Railway Age, May 31, 2022, https://www.railwayage.com/analytics/railpulse-teams-with-railinc/?RAchannel=home.

conditions where it is practicable for a railroad to provide the service and in the public interest.

As a result of turnover by STB members and vigorous objections by the rail industry, the STB did not pursue further action on this issue until 2020. At that time, a reconstituted STB facing an increasing volume of shipper complaints about poor rail service reactivated the proceeding. The STB requesting updated submissions from stakeholders and held public hearings in March 2022. Statements by STB members indicate that they will likely issue a ruling providing expanded reciprocal switching access, but the specifics are not known at this time.[49]

5.3.2 Service Performance

During 2021-2022, freight service performance including adherence to schedules for train operations, yard dwell times, end-to-end travel times and other measures reached historical lows at the largest four Class I railroads – CSX, NS, UP and BNSF. As a result, escalating complaints from shippers about deteriorating service performance (described in Section 5.2.1) caused the STB to act. Notably, this includes addressing general concerns about railroad service through an Ex Parte proceeding, clarifying the railroad's common carrier obligations under the Interstate Commerce Act, and issuing an emergency service order for the first time in years.[50]

Most far-reaching has been the STB's proceeding *Urgent Issues in Freight Rail Service*, EP-770, in 2022. Public hearings held April 26 and 27, 2022, with extensive testimony describing the deterioration in rail service that has occurred in recent years. Railroad executives attributed recent service problems labor shortages and other issues resulting from the COVID-19 epidemic. Shippers' witnesses and STB board members attributed the problems to flawed operating plans that railroads had adopted under the guise of Precision Scheduled Railroading (PSR). Thus far, the STB has been reluctant to issue mandates for operational to

[49] STB seems likely to move ahead with a new reciprocal switching rule, Trains NewsWire, March 17, 2022 https://www.trains.com/trn/news-reviews/news-wire/stb-seems-likely-to-move-ahead-with-a-new-reciprocal-switching-rule/.

[50] STB Issues Emergency Service Order to UP, Railway Age, June 20, 2022, https://www.railwayage.com/regulatory/stb-issues-emergency-service-order-to-up/.

the railroads, instead requiring certain railroads to submit recovery plans, as well as to provide additional data on service performance.[51]

What constitutes meeting the obligations of a common carrier is the subject of a case with a Minnesota shipper that was initiated in 2021 (Docket NOR 42171). Sanimax, which renders animal waste and restaurant grease, is "seeking redress for UP's failure to provide reasonable and adequate rail transportation" following unilateral changes in rail service that has created "significant, untenable, hardships" for Sanimax. Since the Staggers Act, the STB (and the Interstate Commerce Commission before that) has given broad leeway to railroads in determining how to serve their customers, primarily on the grounds that the public interest is best served by ensuring the financial health of the rail industry by maximizing efficiencies. Furthermore, the common carrier rules are extremely vague and poorly defined.

With this case, the STB is wading into the complexities of common carrier obligations, shipper needs and railroad performance for the first time since it was established as the successor to the Interstate Commerce Commission in 1996. The outcome could set a precedent in determining whether the common carrier obligation requires a certain adequacy of service.[52]

5.3.3 Commodity Exemptions

A major goal of economic deregulation that began in the mid-1970's and culminated with the Staggers Rail Act in 1980, was to give the rail industry greater flexibility in setting prices and service for commodities and markets that were inter- and intra-modally competitive. This led the regulator to exempt certain commodities from regulatory review, including all intermodal traffic (trailer and container), fresh fruits and produce, and certain bulk commodities, particularly where traffic was primarily short-haul (less than 250 miles). Over the years, various industries have pursued having select commodities be subject to regulatory review, arguing that markets have become less inter- and intra-modally competitive, thus burdening shippers with excessive costs and inferior service. Railroads counter that there are

[51] STB Requires Additional Service Reporting From Railroads, May 6, 2022, https://www.stb.gov/news-communications/latest-news/pr-22-28/.

[52] Small shipper's case against Union Pacific tests railroad common-carrier obligation, Trains Magazine Newswire, June 15, 2022, https://www.trains.com/trn/news-reviews/news-wire/small-shippers-case-against-union-pacific-tests-railroad-common-carrier-obligation/.

few commodities that are not modally competitive, and that geographic competition further limits the railroad's bargaining power in setting rates and service.

These efforts gained little traction until 2016, when the STB initiated a proceeding to re-examine exemptions for select commodities. Under Ex-Parte 704, Review of Commodity, Boxcar, & TOFC/COFC Exemptions, the STB is considering re-imposing regulatory oversight on a group of commodities that includes scrap metal, aggregates, Portland cement.[53] As of summer 2022, a decision has yet to be made by the STB.

5.3.4 Differential Pricing

Specifically permitted in the Staggers Act, differential pricing allows railroads to charge different rates to different customers Though there is no specific STB proceeding regarding differential pricing, it is a common concern among shippers who believe that rail rates are excessive. Shippers that have competitive options, either across modes or between multiple rail carriers, generally face lower transportation costs than those that do not. Railroads argue that while these customers may pay lower rates, the revenue that the railroads earn from handling this business contributes to the overall cost of providing service, thus reducing the rates charged to customers that do not have intra- or inter-modal options. Railroads further argue that differential rates have enabled them to serve and maintain an expansive North American network that would otherwise not be possible. The subject of many academic and trade association studies, differential pricing (also often referred to as Ramsey Pricing) is a complex issue, and one where it would be extremely difficult to achieve any kind of consensus around not only the impacts, but more importantly any alternatives.

5.3.5 Revenue Adequacy

As set forth in the Staggers Act, revenue adequacy is calculated by the STB to assess the financial health of individual railroads, which affects the railroads' specific abilities to set rates for regulated commodities. Few Class I railroads were found to be revenue-adequate using the STB's methodology until after 2010. As a result of this continued financial improvement, the STB initiated Ex Parte 772 in 2014 to explore the methodology for determining railroad revenue adequacy. Revenue adequacy calculations were designed to measure the

[53] Review of Commodity, Boxcar, and TOFC/COFC Exemptions, https://www.federalregister.gov/documents/2020/10/05/2020-21925/review-of-commodity-boxcar-and-tofccofc-exemptions.

financial health of railroads, and the regulator (now the STB) was left to grapple with developing an equitable approach for regulating rates once revenue adequacy was achieved. In addition, the Staggers Act does not specify how long a railroad must be revenue adequate before it is subject to more stringent economic regulation. Not surprisingly, the positions taken by shippers and the railroads are diametrically opposed. The railroads argue that using revenue adequacy as reason to limit rail rates contradicts the idea of an open market, while shippers argue that the railroad's characteristics as a utility call for regulation of rates to prevent excessive returns. The Board has been exploring this topic with their own initiatives and with ex-parte communications that were explicitly permitted in March 2018 by Board decision.

5.3.6 Amtrak Gulf Coast Service Case (FD-36496)

Following the devastation of Hurricane Katrina in 2005, Amtrak suspended service of its tri-weekly *Sunset Limited* between New Orleans and Jacksonville, Florida pending repair of the extensive damage along the route that follows the Gulf coastline. However, after the repairs were completed, the service was not reinstated. Several years later, the Southern Rail Commission (SRC), together with other groups advanced an initiative to reinstate service along the route, with a first phase consisting of a regional service between New Orleans, Louisiana and Mobile, Alabama. While general agreement on the proposed concept was reached among the public partners, including the SRC, the states, FRA and Amtrak, getting buy-in from Class I railroads CSX and NS, over which the service would operate, proved difficult. The railroads argued that at least $2 billion in infrastructure improvements were necessary to mitigate potential impacts on freight service, versus less than $100 million in necessary improvements that Amtrak, SRC and FRA determined through their analysis.[54] In March 2021, Amtrak, with the support of the SRC, declared an impasse and sought an STB order to allow twice-daily service to commence along the route. In mid-2022, an STB decision on this case, *Amtrak Application to Operate Gulf Coast Service* (FD-36496), was pending.

What makes case FD-36496 of national interest is that it is the first case arguing over Amtrak's statutory rights of access in a 21st Century context. Since its creation in 1971, these rights allow Amtrak to access the rail network as an incremental user, i.e. it is only obligated to pay

[54] https://www.railwayage.com/passenger/intercity/amtrak-stb-petition-cites-csx-ns-unwillingness-to-engage-meaningfully/?RAchannel=home

for the direct costs associated with its operations. With the Gulf Coast case, NS and CSX argue that the passenger carrier should not only offset clearly identified impacts in the present, but potential impacts because of future freight traffic volumes as well, and at levels of operational performance that substantially exceed standards set by the FRA and STB. Advocates for the Gulf Coast passenger service argue that requiring Amtrak to meet such a standard would greatly increase the cost of any potential expansion of existing or new service, thereby rendering such services difficult, if not impossible to implement. A further concern is that NS and CSX are asking to fund capacity improvements on a route that is handling less freight traffic than was the case in 2005, with the additional capacity in part needed due to operational changes that effectively reduce the efficiency of physical plant utilization.

As a result, the outcome of this case is likely to have national repercussions on the operating performance and economics of utilizing privately owned trackage for passenger service. For example, if proponents of a new or expanded service are required to make capital investments in anticipation of future freight traffic growth and not just existing traffic, these arguably speculative needs can greatly increase not only the initial up-front capital costs, but as ongoing costs as well. The Gulf Coast situation is not unique; other examples of similar circumstances include Amtrak's stillborn attempts to expand service on the *Sunset Limited* from tri-weekly to daily. In that case, UP, the host railroad, claimed that daily frequencies would require an investment of over $750 million in capacity improvements along the route.[55]

5.3.7 Train Crew Size

In 2014, FRA implemented rulemaking FRA-2014-0033 with the intent of requiring a minimum of two crew members for most train operations, even though single-person head-end crews have been common for years in passenger service and some freight operations. The rule allowed exceptions for one-person crews in operations that the FRA believes do not pose significant safety risks. In the notice of proposed rulemaking, the FRA conceded that it did not have data to suggest that two-person crews are associated with higher levels of safety than one-person crews. However, anecdotal evidence of rail incidents led them to consider two-person crews as a safer operation.

[55] https://cs.trains.com/trn/b/fred-frailey/archive/2010/09/03/is-a-daily-quot-sunset-limited-quot-worth-750-million.aspx

In 2021, the FRA announced their intention to revisit the crew size issue. This culminated in the issuance of a new proposed rulemaking FRA-2021-0032 on July 28, 2022. The proposed rule appears to be rather similar to the 2014 version, and with the same pro and con arguments.

Although most train operations already call for two crew members, railroads are resistant to being required to have a minimum of two crew members. They see a mandate as excessive regulation that prevents them from making common sense operational decisions based on actual conditions. Furthermore, the deployment of Positive Train Control allows enforcement of operating rules in many safety-critical situations, thus diminishing the argument that a second crewmember is required for this purpose.

Rigid application of a two-person head end crew on passenger services could cause significant impacts on passenger operators, including Amtrak. In most corridor operations, Amtrak has utilized one-person head-end crews since the 1980's, and with an exemplary safety record. Requiring a two person head-end crew would result in substantial labor cost increases, thereby worsening the economics of operating these services and raising the subsidy requirements. Furthermore, given the very tight labor markets, recruiting, training and retaining additional operating personnel are likely to be challenging for Amtrak and its partners, potentially placing some services at risk.

5.3.8 Truck Size and Weight

A perennial issue, the federal maximum weight for standard highway tractor combinations, has been set to 80,000 pounds since 1983, and long combination vehicles were limited to certain highways located primarily in Western U.S. since 1991. However, over the last 20 years, individual states have given exemptions for weight limits to various industries, and the pressure to broadly increase weight limits at the federal level has grown increasingly intense. The economic impact on the rail industry of a nationwide increase in truck size and weight has been a matter of contentious discussion for many years. However, any significant changes in truck size and weight beyond current limits that are broadly applicable will provide productivity gains to trucking firms that will tilt modal economics more toward highway transport. Short lines are likely to bear the brunt of these impacts disproportionately, given their heavy orientation toward small-volume carload traffic. One study found that an increase in truck weight from 80,000 to 97,000 pounds could reduce merchandise traffic volumes by 44%, and overall rail traffic by 19% (AAR, 2020a).

In 2012, Maine and Vermont jointly began an Interstate Highway Heavy Truck Pilot Program. Both States chose to replace current Federal commercial-vehicle weight regulations with State laws, as allowed by P.L. 111-117. Maine now allows 6-axle tractor semitrailers that weigh up to 100,000 pounds gross vehicle weight and trucks with tandem axles that weigh up to a maximum of 46,000 pounds for hauling many commodities on non-tolled Interstate highways.

A change in weight restrictions for trucks can undercut rail's competitive advantage for certain commodities and customers, to a point where some regional and short line railroads may be driven out of business.

5.3.9 Trade Agreements

In July 2020, The US-Mexico-Canada Agreement (USMCA) replaced the 25-year-old North American Free Trade Agreement (NAFTA). USMCA was designed to be a more flexible and modern trade agreement, aiming to improve rules of origin for automobiles and other vehicles; bolster disciplines on currency manipulation; modernize and strengthen food and agriculture trade; create new protections for U.S. intellectual property; and ensure trade opportunities for U.S. services.

More broadly, international trade plays a critical role in freight rail's viability; as of 2017, 42% of rail carloads and intermodal units nationwide were directly associated with international trade, and 35% of annual rail revenue was directly associated with international trade. Particularly with the possibility of a combined CPKC Class I carrier that reaches Canada and Mexico, the USMCA has the potential to spur growth in international rail freight imports and exports to and from Maine.

A specific concern for Maine's railroads is an FDA reporting requirement for agricultural goods that are imported into or transiting the United States. This has a direct bearing on CP's operation across Maine, and its desire to handle agricultural products in intermodal service between the Atlantic provinces and the rest of Canada, as well as the US Midwest. Shippers view the reporting requirements as complex and time consuming, and thus are less inclined to use CP's service across Maine. Presently CP and several shippers are engaged in efforts to simplify these reporting requirements for international traffic transiting Maine.

5.4 Passenger Rail Trends

5.4.1 Impact of COVID-19 on Passenger Rail Ridership

While all shared-use passenger services were severely impacted by the COVID-19 pandemic, recovery in intercity markets has been robust since late 2021. That includes the Downeaster, for which ridership has been approaching pre-pandemic levels in mid-2022. Importantly, ridership at stations in Maine have seen faster growth over the past year than stations in New Hampshire or Massachusetts. As the ability of white-collar workers to perform their duties remotely increases due to enhanced technology and weakened ties to central offices, it is possible that Maine will become an increasingly popular destination for remote workers in New England, particularly for workers looking to escape higher costs-of-living in the Boston area. However, as of mid-2022 it is still rather unclear what direction these trends will actually take.

5.4.2 Rolling Stock

In addition to developments in moving away from carbon-based fuels for propulsion, described in 5.2.6, passenger rolling stock is also experiencing technical evolution. Notable has been a reemergence of interest in Diesel Multiple Units (DMUs), which are self-powered diesel rail vehicles, typically operating in 2-4 car units. DMUs feature a lower cost of operation than trains on routes where ridership is relatively modest (fewer than 250 seated passengers) or frequent service reduces the need for high-capacity rolling stock. DMUs may be suitable for several potential corridors in Maine, including Brunswick to Rockland, the Portland-to-Westbrook line, as well as a connection between Portland and Lewiston-Auburn.

Historically, DMU service was common in New England with the country's largest fleet of Budd Rail Diesel Cars (RDC) operated by the Boston and Maine from the 1950's through the 1970s. Since then U.S. commuter railroads and Amtrak have focused primarily on locomotive hauled passenger trains since that time. With the advent of modern FRA-compliant DMUs in the 2010's, they have seen expanded use in North America in commuter rail applications, but thus far none have been deployed in intercity rail service.

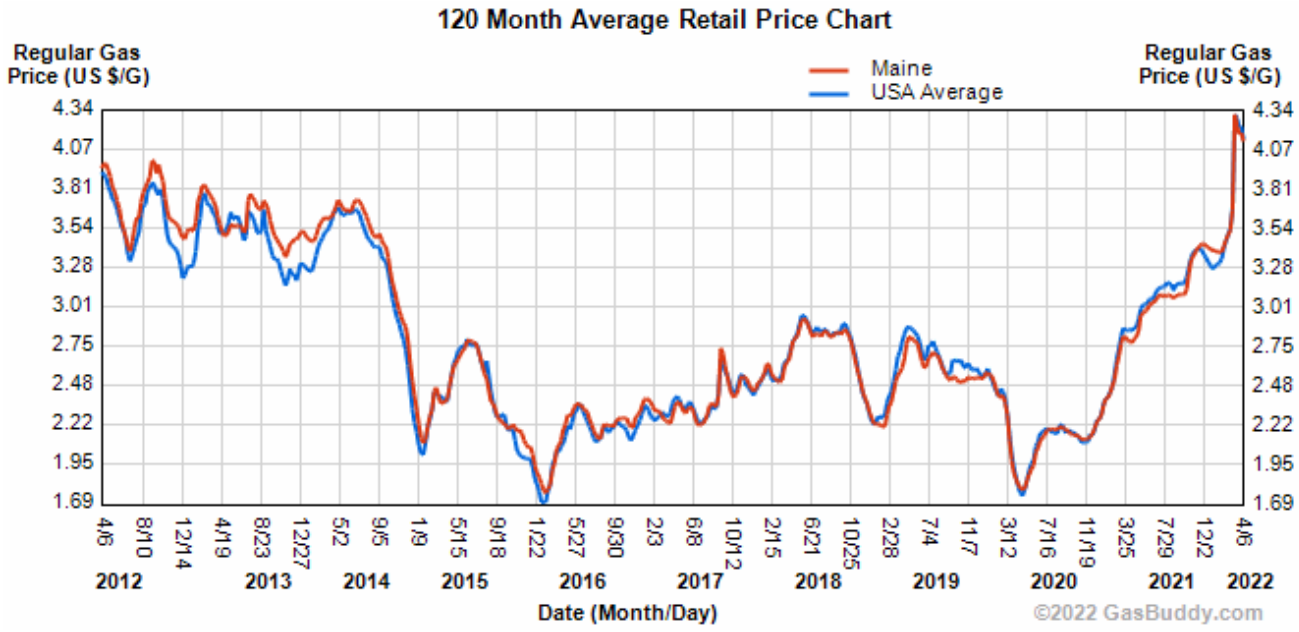
The primary potential benefits from utilizing DMUs is in achieving operating savings through reduced fuel consumption, lower operating labor requirements, and a degree of flexibility not typically available with locomotive hauled trains. DMUs can be coupled together like a

conventional locomotive hauled train, and then be split at a station to serve multiple end-points. Labor cost savings can be achieved through the use of smaller crews. Standard practice in short-haul services is to operate them with a crew of one; in an intercity application as might be applicable in Maine, a larger crew would likely be necessary.

5.5 Fuel Cost Trends

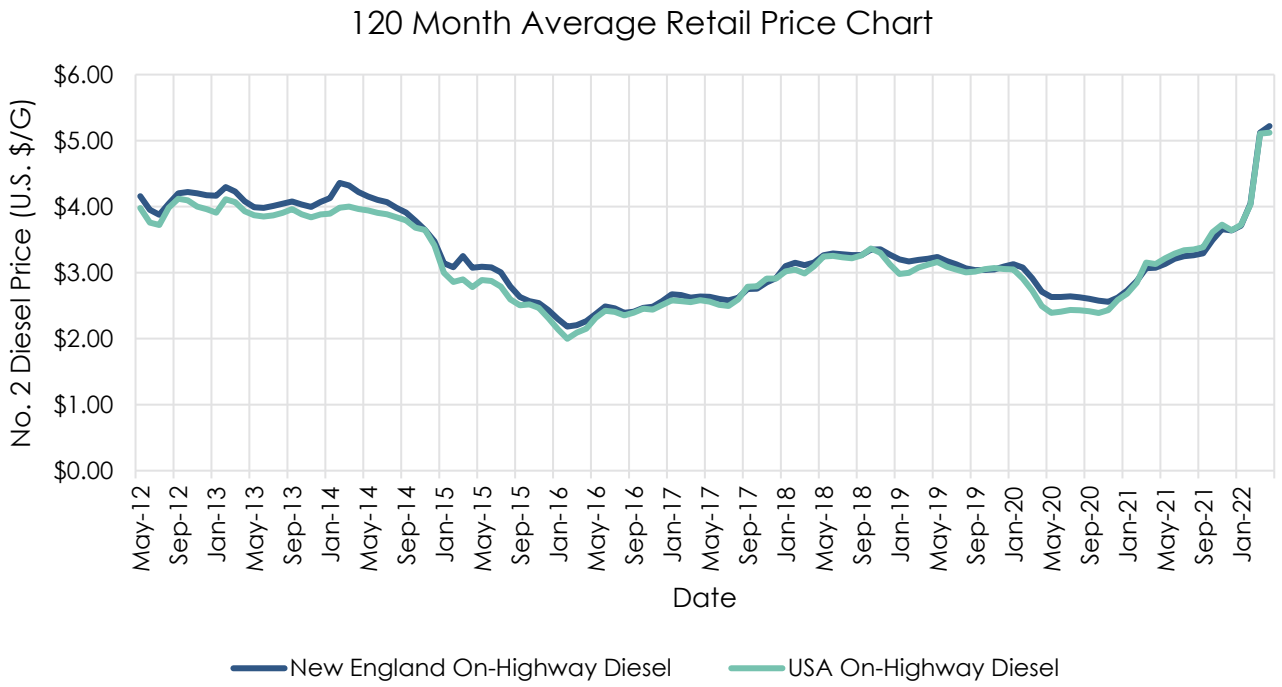
Overall, retail gas prices have increased by only 14 percent over the past decade. However, over that time period there has been significant volatility, with average retail gas prices in Maine ranging from a low of $1.69/gallon in January 2016 to a recent high of $4.35/gallon in early March 2022, as shown in Figure 5.3. The Russian invasion of Ukraine in early 2022 has caused significant disruption in global energy markets, causing sharp spikes in all energy prices.

Figure 5.3 Retail Gas Prices in Maine and U.S. (2012-2021)



Source: GasBuddy

Figure 5.4 Average Diesel Retail Prices, U.S. and New England (2012-2022)



Source: U.S. Energy Information Administration (US EIA)

5.6 Rail Congestion Trends

While rail congestion is not a major concern in Maine, congestion in neighboring states and provinces do have the potential to cause delays for trains entering or departing Maine. These congestion-related concerns apply for both passenger and freight rail. While most of Maine's main lines have more than sufficient capacity for substantial volume growth, the route used by the *Downeaster* between Brunswick and North Station, Boston does face some capacity challenges. Largely single-track in Maine and New Hampshire, the route currently hosts 10 Downeaster trains plus several CSX freight trains, the combination of which raises the likelihood of delays. In Massachusetts, the *Downeaster* uses MBTA's Haverhill Line between Boston and Haverhill. While largely double-track, this section too has some single track, with the result that MBTA commuter trains can delay *Downeaster* trains (and vice versa), impacting its reliability and on-time performance. The impact of CSX's acquisition of Pan Am Railways on freight traffic patterns and volumes in Massachusetts will be an evolving situation that should be monitored to ensure that significant congestion does not materially impact passenger and freight rail services affecting Maine. However, increasing the proportion of

double main along the route of the *Downeaster* will be necessary to ensure the fluidity of passenger and freight operations.

5.7 Highway and Airport Congestion Trends

According to a 2021 study of highway condition and congestion by the Washington, DC-based national transportation research nonprofit TRIP, highway congestion costs Maine drivers $250 million each year in the form of lost time and wasted fuel. In the most congested urban areas, drivers lose up to $568 and as many as 28 hours per year sitting in congestion. Due to the COVID-19 pandemic, vehicle travel in Maine dropped by as much as 40 percent in April 2020 (as compared to vehicle travel during the same month the previous year), but rebounded to 12 percent below the previous year's volume in November 2020[56].

According to the Massachusetts DOT Highway Administrator, while traffic congestion in the Boston region has returned following the peak of the COVID-19 pandemic, the specific traffic patterns vary from the pre-2020 norm. For example, weekday morning commutes on I-95 to Boston have been reduced an average of six minutes between 2019 and 2022.[57] Less traffic on I-95, the principal route from Boston to Maine, could make car travel to Maine easier, reducing passenger demand on the Downeaster.

5.8 Land Use Trends

Maine has three urbanized areas — Portland, Bangor and Lewiston — and 24 urban clusters. Outside of the three urbanized areas, and the state's suburban southern coast in York and Cumberland Counties, most of Maine is predominantly rural, and characterized by low and very low population and development densities. This includes sparsely populated unorganized territories in northern and eastern Maine, and primarily consisting of protected land, rugged terrain, and logging operations.

The change in population between 2010 and 2020 for each of the three urbanized areas is shown in Table 5.1. Between 2010 and 2020, the Portland Urbanized Area was the only one to record population growth. Both the Bangor and Lewiston Urbanized Areas saw population

[56] "Maine Transportation by the Numbers." TRIP: A National Transportation Research Nonprofit, February 2021. https://tripnet.org/wp-content/uploads/2021/02/TRIP_Maine_Transportation_by_the_Numbers_Report_February_2021.pdf.

[57] Lisinski, Chris. "Traffic Is Back, but the Patterns Have Changed." WBUR, March 17, 2022. https://www.wbur.org/news/2022/03/17/traffics-back-boston-patterns-pandemic.

declines of over 4 percent and 1.5 percent respectively. In comparison, the statewide population grew at a rate slightly lower than that of Portland.

Table 5.1 Maine Urbanized Area Population & Population Density Metrics

Geography	Population		Population Density		
	2010	2020	2010	2020	Percent Change
Portland Urbanized Area	203,914	211,123	1,495	1,548	+ 3.5%
Bangor Urbanized Area	61,21	58,677	1,444	1,385	- 4.1%
Lewiston Urbanized Area	59,397	58,479	1,678	1,652	- 1.5%
Maine (Entire State)	**1,328,361**	**1,362,359**	**40.2**	**41.3**	**+ 2.6%**

Source: United States Census

Population projections for Maine's three cities[58] are shown in Table 5.2. These projections, compiled based on 2018 census data, indicate that the population of each of the state's three cities is projected to decline through 2038 by anywhere between 3.5 percent and nearly 15 percent. Given that the population of Maine's urbanized areas have remained stagnant, or declined only slightly since 2010, these trends may indicate that any increases in population in these urbanized areas are likely to occur in suburban locations outside of the urban cores. This especially appears to be the case in and around the Portland Urbanized Area, given a trend of regional population growth overlaid with predictions for population decline in the urban core.

Table 5.2 Maine City Population Projections (2020 – 2038)

City	2020 (Actual)	2028	2033	2038	Percent Change (2020 – 2038)
Portland	68,408	62,850	60,734	58,340	- 14.7%
Bangor	31,753	31,586	31,156	30,623	- 3.5%
Lewiston	37,121	35,346	34,587	34,222	- 7.8%

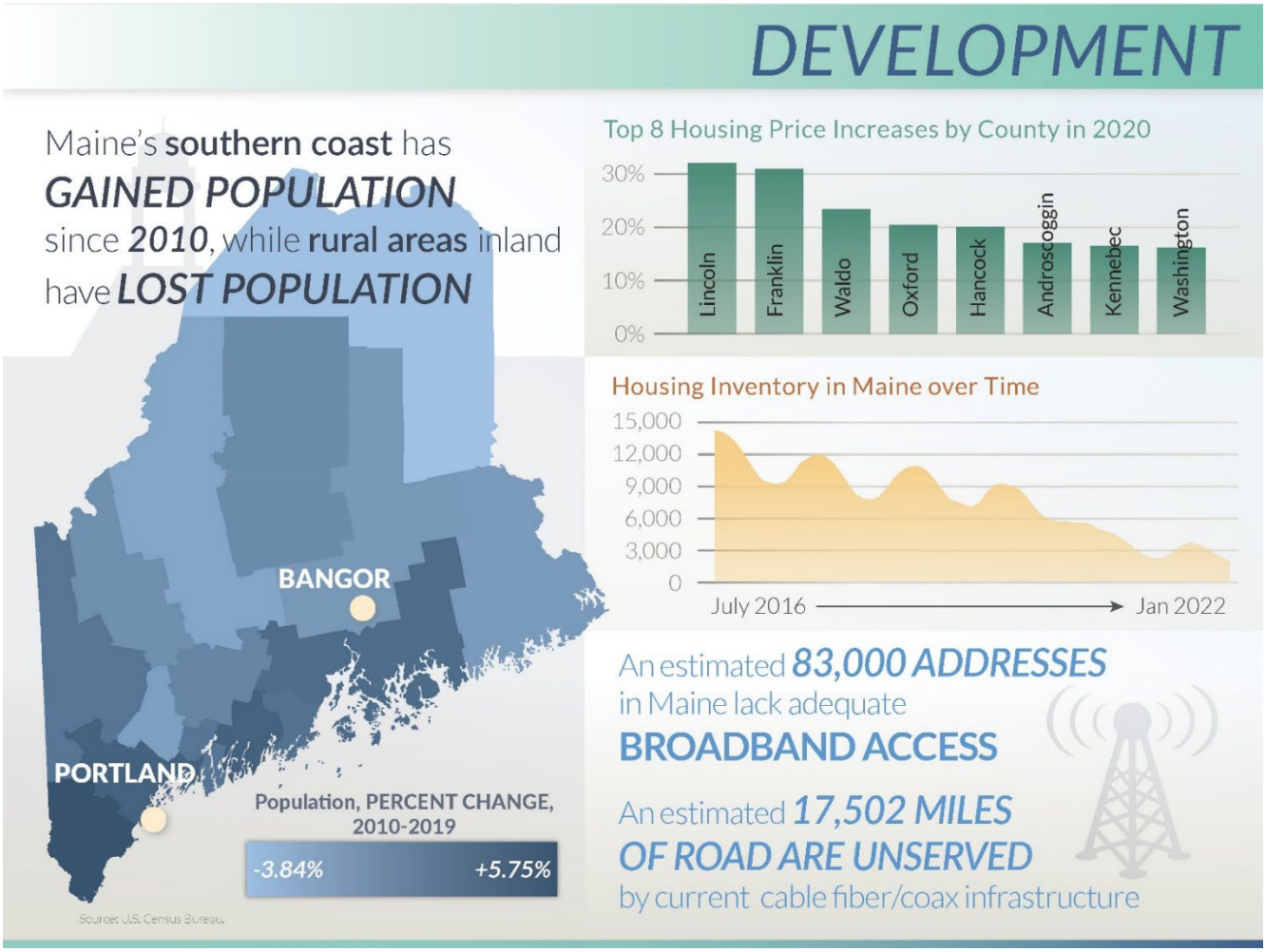
Source: Maine State Economist Population Projections

These observations and predictions are part of a larger trend of growth across the state's suburban southern coast. Driven by proximity to urban centers such as Portland, Portsmouth, and even Boston, along with a strong tourism sector, southern Maine, including York and

[58] Population projections for the state's urbanized areas were unavailable.

Cumberland Counties have seen notable population growth over the past decade. This growth has also led to increases in property values coupled with declining housing inventories (see Figure 5.5). Outside of these portions of Maine, most of the rural counties across central, northern, and central portions of the state have seen population declines. These declines have been driven by multiple factors, including long distances to urban centers, limited local economic opportunities, and limited broadband connectivity/access. As discussed in the Economic Profile Demographic Trends, these particular trends are expected to continue through 2050.

Figure 5.5 Maine Population & Development Trends



Source: Maine Long Range Transportation Plan