Failure to Act: Ports and Inland Waterways–Anchoring the U.S. Economy

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1. Ports and Inland Waterways

1.1 Summary Results

Our nation's ports and waterways move goods domestically and abroad and play a key role in supporting manufacturing, agriculture, and other core industries. There are over 300 deep commercial harbors in the U.S., as well as over 12,000 miles of inland waterways with over 218 locks and 13,000 miles of coastal channels.[1] Waterborne transportation opens markets for international trade that creates ripple effects throughout our economy.

Coastal navigation requires channels of sufficient depth – sometimes to 52 feet – in order to support deep-draft vessels. Inland waterways require channel depths of up to nine feet, and have significant infrastructure by way of locks and dams that allow continuous navigation as river water levels change. Capital construction and major rehabilitation of both coastal and inland waterways rely on both private and public funding sources. Public funds are allocated to the U.S. Army Corps of Engineers projects based on Congressional appropriations. Several funding sources are available for supporting these appropriations, but the major sources are the Harbor Maintenance Trust Fund (HMTF) and the Inland Waterways Trust Fund (IWTF).[2]

Unfortunately, available funding for inland waterway and port infrastructure has been insufficient to date. This Failure to Act report quantifies the chronic underinvestment in our ports and navigation channels as well as what continued deferred maintenance will cost our economy. The investment gap for coastal ports and inland waterway infrastructure is relatively unchanged over the last 10 years, which is better than how most other transportation infrastructure sectors are faring. The federal government and private partners have increased spending over the past decade to invest in navigational channels and port waterside infrastructure, through measures such as authorizing spending from the Harbor Maintenance Trust Fund and increasing the IWTF barge fuel taxes.

The U.S. Department of Transportation (USDOT) Freight Analysis Framework (FAF) freight forecasts suggest total water tonnage will increase at an annual growth of 0.7% per year through 2040. Adjusting for inflation, freight forecasts, and recent navigation spending for coastal and inland waterways,[3] our estimate show a funding gap of $24.8 billion for the period 2020 through 2029, and $23.8 billion for 2030 through 2039. This gap applies to navigational related waterside improvements, including dredging, and lock and dam repair, and not privately owned landside infrastructure and capital equipment.[4]

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1 U.S. Army "FY2019 U.S. Army Corps of Engineers Annual Financial Report."

2 The IWTF is funded by the $0.29 per gallon federal tax (inland waterway user fee) on commercial- barge fuel on federally designated waterways.

3 Such as Maritime Administration's (MARAD) recently funded Port Infrastructure Development Program (PIPD).

4 Does not include other capital needs like levies, the environmental projects, or other items included in the overall USACE budget.

Table 1: Estimated Funding Need and Gap in Millions of Dollars for Navigation

	Estimated Need	Estimated Funding	Unfunded
2020-2029			
Inland Waterways	$19,570	$7,010	**$12,560**
Coastal Ports	$22,210	$9,960	**$12,250**
Total	**$41,780**	**$16,970**	**$24,810**
2030-2039			
Inland Waterways	$19,570	$7,980	**$11,590**
Coastal Ports	$22,210	$9,990	**$12,220**
Total	**$41,780**	**$17,970**	**$23,810**
2020-2039			
Total	**$83,560**	**$34,940**	**$48,620**

The inland waterways funding gap is almost entirely for lock and dam infrastructure, which is largely antiquated and prone to failure. Approximately 10% of the $24.2 billion in unfunded projects over 20 years is for dredging, primarily in portions of the Mississippi River. Comparatively, the needs in ports is primarily dredging harbors to accommodate larger ships now common in global trade.

The failures to meet investment needs in marine ports and inland waterways will create channel depth limitations and lock and dam chamber operation inefficiencies. Narrow, shallow channels and harbors and outdated facilities are costly in terms of delays and productivity. This will lead to increased costs to businesses due to more time and out of pocket expenses required to transport commodities within the U.S., as well as between the U.S. and international markets. Shipment of goods will become more costly and time consuming. “On-the-clock” hours will increase resulting in higher labor costs and other indirect costs, such as inventory delays associated with shipping. In addition to greater carrying costs, unreliable freight transportation increases the need for excess inventory, known as “safety stock,” to cover anticipated reliability issues as well as the potential for unanticipated demand or supply issues.

Both domestic and international trade will be affected by the increased costs associated with sub-optimal performance of the waterways systems attributable to public investment gaps. By 2039, costs of waterborne shipping will increase on average 8% to 22% above costs in 2019 (Table 2). These increased supply chain costs will make U.S. products and services more expensive and less competitive or affordable, especially in export markets. For example, increased costs for exports in the energy and agricultural sectors translate into less competitive pricing, which in turn harms our ability to retain and acquire international market share.

Table 2: Average Increased Cost of Waterborne Commerce, from 2019 to 2039

Freight Segment	Average Increased Cost	Segment of Freight System
Domestic-Inland	22%	Inland Waterways (locks, damns and associated infrastructure)
Exports	8%	Coastal Channels and Ports
Imports	17%	

Source: Calculations by EBP

The impact on the U.S. economy

Manufacturing, agriculture, and production and extraction are most impacted by underinvestment in inland waterways and coastal channels and ports. These sectors and infrastructure are critical economic drivers, as they support a diversified national economy and contribute to a favorable balance of trade.

Without addressing the capital investment gap, in the year 2039 GDP will be $219 billion beneath expected value that year, and the 20-year cumulative loss in GDP will be almost $1.9 trillion (in 2019 dollars). Over the 20-year timespan of this analysis, U.S. households will lose an aggregate total of more than $1.1 trillion of disposable income due to deficiencies in the ports and inland waterways systems. Disposable income is what is used by households to purchase goods and services. From 2020-2029, the average loss of disposable income is expected to be $170 per year per household. During the second half of this study's time period, from 2030 to 2039, disposable income per household is expected to decrease by more than $600 per year on average.

Given these dynamics, now is an opportunity to make progress in addressing capacity issues by maintaining or increasing funding for improving port and waterways capacity. Doing so will ensure the U.S. is in a better position to provide competitive transportation services for exported commodities and maintain the ability to provide importers with efficient and cost-effective inland service.

2. An Overview of Marine Ports and Inland Waterways Infrastructure

Waterborne transportation relies on two types of infrastructure linked to a system of ports – coastal navigation channels and the U.S. inland waterway network. The U.S. waterway system consists of over 12,000 miles of inland waterways and 13,000 miles of coastal channels, with over 218 locks at 176 sites, along with over 300 deep commercial harbors.[5]

Coastal navigation requires channels of sufficient depth to support deep-draft vessels that are now more common with the expansion of the Panama Canal. Ships used for international trade that call on U.S.

[5] U.S. Army "FY2019 U.S. Army Corps of Engineers Annual Financial Report."

marine ports have varying draft requirements, with the largest container vessels requiring channel depths of at least 52 feet when fully loaded.[6]

The ability of a port to accept ships of varying size is critical, as doing so keeps the nation economically competitive and capable of engaging in international trade. Approximately 63% of U.S. imports arrive to the U.S. by water, including 68% of the nation's crude petroleum imports. Approximately 71% of U.S. exports by tonnage, accounting for approximately 41% of total exports by value, are transported by water to foreign markets.[7]

Three types of trade have required the deepening of navigational channels for coastal ports:

- Containerized imports from Asia;
- Exports of crude oil and petroleum products; and
- Exports of liquified natural gas.

Inland waterways do not require such deep channels – a typical depth is nine feet. The inland waterways network, which is managed by the U.S. Army Corps of Engineers, relies on a system of locks and dams along designated U.S. river routes – otherwise known as the marine highway – which raise and lower barges and shallow draft cargo ships, permitting continuous navigation as water levels change along the inland waterway system. A lock and dam work in the following way: when a ship reaches a lock, a gate opens, and the ship enters the lock chamber. Once the ship is inside the chamber, the gate closes and water either fills or empties from the lock chamber. When the ship is level with the water on the other side of the opposite gate, the opposite gate opens for the ship to proceed.[8] Most traffic on the inland waterway system consists of either barge tows or recreational boats.

Originally designed in the 1930s, most of the lock and dam chambers on the major inland waterways are limited to barge tows of 600 feet. Modern barge tows consist of 15 barges, each of which is typically about 200 feet long and 35 feet wide. Antiquated infrastructure typically requires that tows be disassembled at each lock in order to pass through, and then reassembled after all barges in the tow have transited the lock. This can result in longer transit times and increased costs for the tug and crew.

The U.S. lock and dam system has chronic operational problems linked to years of underinvestment. Limitations of lock operations often mean extensive delays in passing barge tows through the lock system, driving up costs (due to the time required for crews to disassemble and re-assemble tows) and creating significant delays during periods of peak demand.

Domestically, 4% of freight by tonnage, and 3% of freight by value, is transported by water.[9] This includes approximately 14% of all crude petroleum, 3% of all coal and 16% of other fuel oils, which alone affect the efficiency of all economic sectors that rely on energy. In addition, agricultural products heavily rely on the inland waterways for transport to coastal ports for export. The U.S. Department of Transportation

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6 Post-Panamex deep draft vessels require at least 52 feet of channel depth when fully loaded. However, these newer vessles are not currently servicing US markets.

7 Freight Analysis Framework 4, 2020 estimates.

8 https://www.gao.gov/assets/700/695255.pdf

9 Freight Analysis Framework 4, 2020 estimates.

(USDOT) Freight Analysis Framework (FAF) freight forecasts suggest total water tonnage will increase at an annual growth of 0.7% per year through 2040.

3. Coastal Ports: Freight Trends

It's estimated that American ports will move more than 770 million tons of imports and 894 million tons of exports in 2020.[10] Marine ports primarily move three types of freight: bulk, containerized, and roll-on/roll-off (noncontainerized motor vehicles). Recent shifts in trade-related industries are necessitating infrastructure investment, along with routine maintenance at ports.

Some of the starkest changes have occurred in the energy industry. The 2015 Fixing America's Surface Transportation (FAST) Act removed the general prohibition on exporting U.S. crude oil, a ban that extended back to the oil shocks of 1970s. The authorization of crude exports increased demand for facilities and operations at U.S. seaports to receive, store, and load crude oil onto oil tankers. In addition, with the advances in shale gas production technology in the U.S., and the opening of international markets to U.S. liquified natural gas (LNG) in 2016, exports of LNG have soared. A wide range of LNG export terminals have opened in recent years. Although primarily in the Gulf of Mexico region, LNG export facilities have also been constructed in the mid-Atlantic to accommodate LNG exports from shale fields in the Marcellus and Utica fields. Most LNG is transported in vessels requiring channel depths of about 40 feet. Larger vessels are in production for non-U.S. export, but limitations of receiving ports may inhibit their size in the near term

Additionally, warehousing and distribution hubs are shifting. For example, an increasing number of warehouses and distribution centers have been built in the Southeast and South-Central U.S., contributing to dramatic container growth at the Ports of Houston, New Orleans, Savannah, and Charleston. International markets for grains and oil seeds have begun to shift from east Asia to South America and Africa, necessitating a nimble inland navigation system and export infrastructure. Canadian and Mexican ports have also invested significantly in their port capacity to offer shipping alternatives for goods and products destined for U.S. markets.

Another major shift in freight movement has related to the rapid growth of U.S. container trade. This trend was observed beginning in the early 1970s but accelerated in recent years (Figure 4). As recently as 2006, the largest container vessel in service was just over 11,000 20-foot equivalent units (TEUs).[11] By 2019, vessels calling on the U.S. were just under 20,000 TEUs.[12] A combination of factors, including new emissions regulations for vessel operations, intense price competition, and consolidation of liner services has provoked rapid redeployment of vessels in service, as shipping companies scrap smaller vessels (in the 5,000 to 7,000 TEU range) in favor of larger container vessels. Many coastal U.S. ports have responded by deepening navigational channels to accommodate the 50-foot or more draft required by these vessels.

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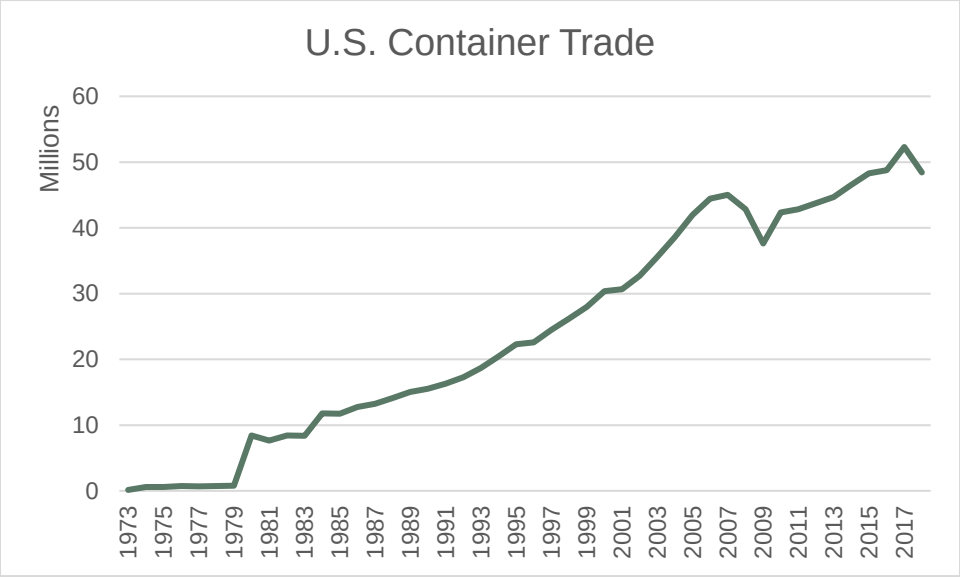
[10] Freight Analysis Framework 4, 2020 estimates.

[11] History of Container ship Design (TEU Growth): http://www.worldshipping.org/about-the-industry/liner-ships/container-ship-design.

[12] United Nations Conference on Trade and Development, UNCTAD Data Center, https://unctadstat.unctad.org/wds/TableViewer/tableView.aspx. (vessell call based upon containers onboard, vessell may not have been fully loaded, therefore not a full 22,000 TEUs)

Figure 1: Trends in U.S. Container Trade

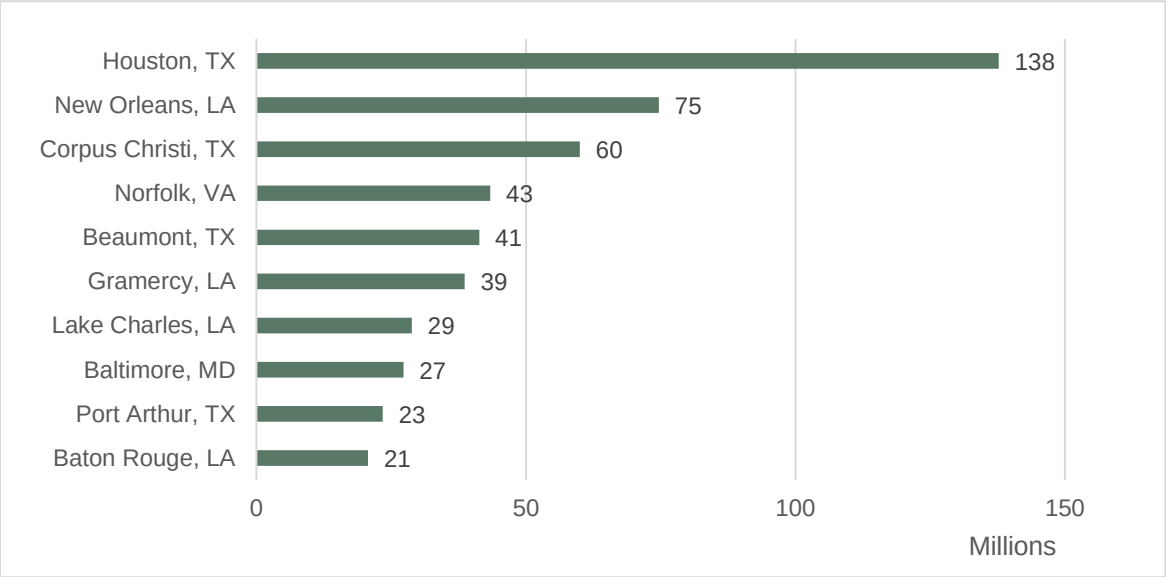


Source: American Association of Port Authorities (AAPA), "Container Traffic in North America,"

3.1 Commodity Flows by Port

The top 10 marine ports accounted for 62.5% of all U.S. waterborne exports in terms of tonnage. Total exports for 2019 were 794 trillion tons, with an export value of $587 billion. The Port of Houston was the largest exporter in terms of total tonnage, followed by the Ports of New Orleans and Corpus Christi, as shown in Figure 2. These large Gulf ports export significant quantities of petroleum and agricultural product – both commodity groups with high volume/tonnage, but relatively low value (compared to manufactured goods). The Port of Corpus Christi was the first to export U.S. crude oil after the lifting of the export ban and saw a total export tonnage growth of 43% in the first year. The growth in LNG exports around the same time was another contributing factor to the overall growth in Gulf port exports. The integrated access of the Gulf ports to the inland water transport system via the Mississippi River also enables high export volumes with these growing commodities. The Port of Los Angeles and Port of Long Beach individually rank 11th and 12th in terms of export tonnage, but when combined as a single region, are the third largest port for exports in terms of combined tonnage.

Figure 2: Top 10 Ports by Export Tonnage 2019



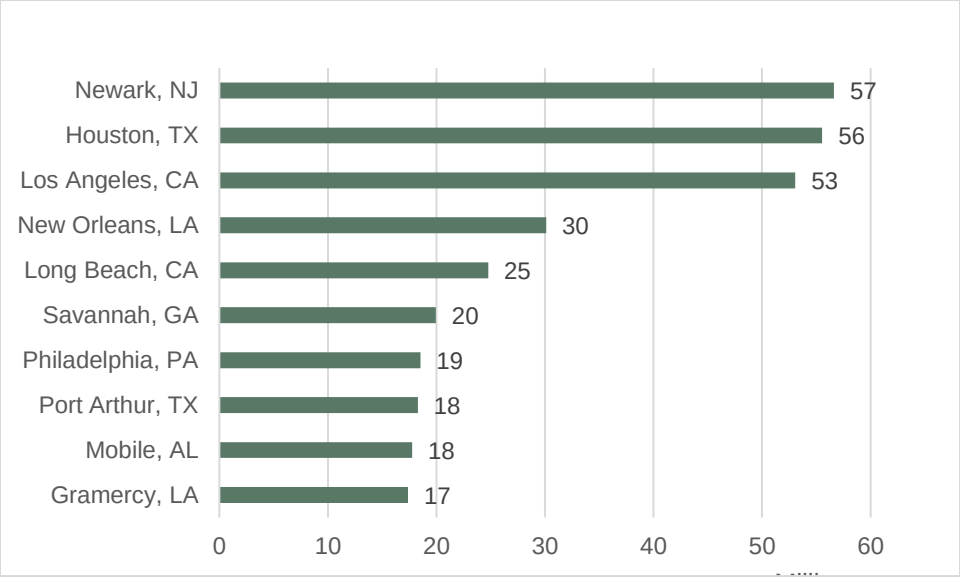
Source: WISERTrade: Port HS Database.

Total imports amounted to 609 trillion tons and the top 10 ports by import tonnage represented 51% of all tonnage imported to the U.S. Imports for 2019 totaled $1.1 trillion in value. In general, total containerized freight handled was up 16.8% from 2015 to 2018 at the top 25 U.S. ports. They moved a total of 54 million TEUs.[13]

Figure 3 shows the total tonnage of imports for the leading 10 ports in the nation. Looking into the major commodities and containerized goods for each port reinforces the overall U.S. trade trend of importing higher value manufactured goods and exporting heavier, lower value bulk exports. Note that containerized cargoes rely on surface transportation access provided by highway and rail connections.

[13] USDOT Bureau of Transportation Statistics, "Port Performance Freight Statistics in 2018, Annual Report to Congress 2019."

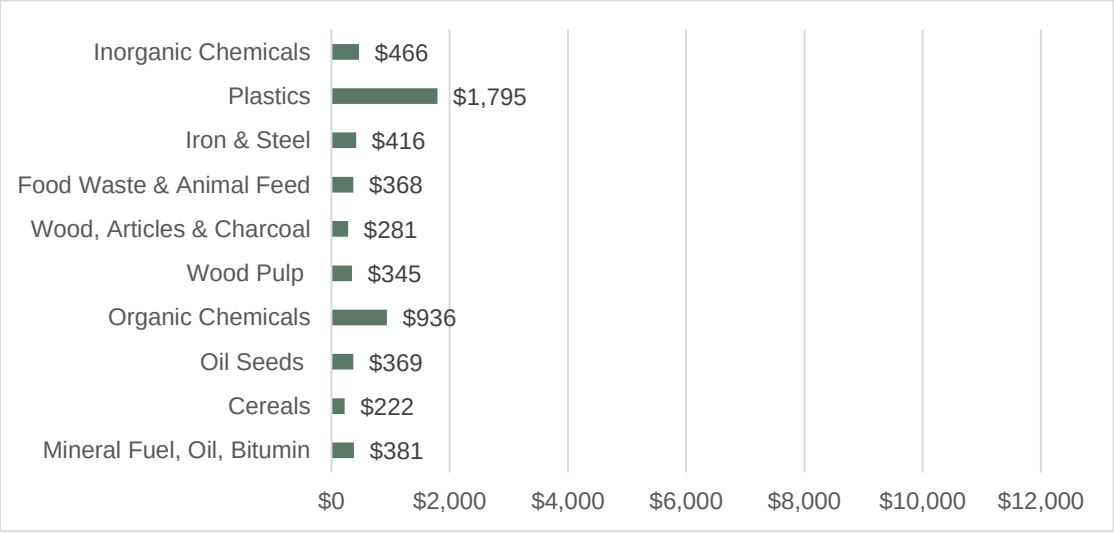
Figure 3: Top 10 Port by Import Tonnage 2019



Source: WISERTrade: Port HS Database.

On a commodity basis, the U.S. is exporting heavier weight, lower value commodities and importing lower weight higher value commodities overall. As Figure 4 and Figure 5 show, the top 10 commodity export value per ton is quite low relative to the top 10 commodities imported.

Figure 4: Top 10 Export Commodities in 2019 – Value per ton



Source: WISERTrade: Port HS Database.

Figure 5: Top 10 Import Commodities in 2019 – Value per Ton

Source: WISERTrade: Port HS Database.

4. Inland waterways: Freight Trends

Inland waterways move large quantities of non-time-sensitive bulk commodities at relatively low cost. Bulk imports are usually tied to local markets, where the imports are consumed by households, businesses and industrial customers located near the port of entry. On the other hand, bulk exports often require longer linkages and logistics considerations between the places where exports are initially produced and the coastal ports transporting these bulk exports. The U.S. inland waterways and rail systems provide these vital connections between points of origin and coastal ports.[14]

The largest commodities shipped via U.S. inland waterways by tonnage or volume are coal, petroleum products, agricultural products, aggregates, and chemicals. The U.S. Department of Agriculture estimates that agricultural exports accounted for over 20% of total U.S. agricultural output between 2008 and 2018, and that agricultural exports alone supported over 1.05 million jobs, including and an estimated 691,000 jobs in the non-farm sector. Map 1 shows the US Inland and Intracoastal waterway system. The lower Mississippi and Columbia rivers are key routes for grain and other agricultural products for export, accounting for 60% of agricultural volumes.[15] The Mississippi River System handles 57% of U.S. corn exports by volume (valued at $4.8 billion) and 59% of U.S. soybean exports ($12.4 billion), as well as 55% of soybean meal exports.[16]

14 This applies to ocean cargo as well as shown by the presence of petroleum exports from the ports of Baltimore and Norfolk as well as the traditional Gulf ports.

15 USACR, "Inland Waterway Navigation Value to the Nation."

16 Agribusiness Consulting, "Importance of Inland Waterways to U.S. Agriculture," 2019.

Map 1: Inland and Intracoastal Waterways System

Source: USACE Navigation Data Center GIS Viewer.

Some of the major commodity corridors for the inland waterways are: [17]

- Coal corridor: Ohio River system, including the Allegheny and Monongahela Rivers;
- Food and farm corridor: Upper Mississippi and Illinois Rivers to New Orleans, Louisiana;
- Petrochemical corridor: Mississippi River from Saint Louis, Missouri, to New Orleans;
- Manufactured goods corridor: Mississippi River from Saint Louis to New Orleans;
- Crude materials corridor: Ohio and Upper Mississippi Rivers (from Saint Louis) to New Orleans;
- Food and farm corridor: Columbia River system, including Columbia, Snake, and Willamette Rivers;
- Chemical and petroleum goods corridor: Gulf Intracoastal Waterway

[17] National Academies of Sciences, Engineering, and Medicine, "Funding and Managing the U.S. Inland Waterways System: What Policy Makers Need to Know: What Policy Makers Need to Know," 2015.

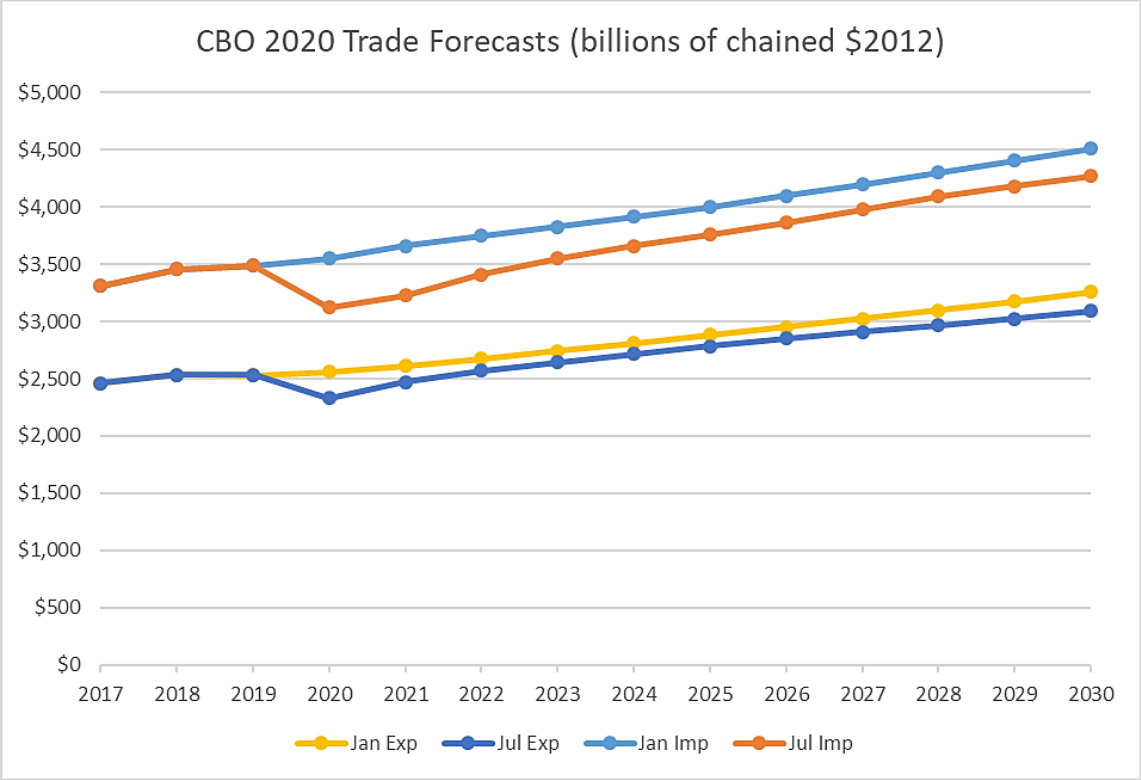
5. Economic Conditions and Funding Gaps

Until the recent impacts attributed to COVID-19, national economic conditions had recovered from the Great Recession and the economy was growing. Exports and imports as measured by weight and volume were increasing. Strong economic growth continued throughout the end of 2019 with national unemployment rates below 5% and GDP growth for the year 2.3%.[18] The strong economic headwinds bolstered trade growth. However, due to disruptions in long-standing trade agreements, import tonnage began to decline, falling by 2.8% in 2018 and by 8.1% in 2019.[19]

Changes in the U.S. and global economies continue to affect demand for transportation, including port demand. Despite increased tariffs and reshoring efforts, total trade volumes have continued to grow in the last five years. The ports are directly affected as increases in trade volume challenge the existing capacity as well as expansion plans.

However, at the onset of the global COVID-19 pandemic, economic growth slowed and continues to lag behind 2019 levels. Employment forecasts by the Congressional Budget Office (CBO) suggest that growth may return to the original trajectory but at a smaller base in late 2021. However, employment and income levels will still lag 2019 levels beyond 2022.

Figure 6: CBO Trade Forecasts 2020 – 2030



Source: U.S. Congressional Budget Office Trade Forecasts, July 2020.

[18] Bureau of Economioc Analysis, «Gross Domestic Product, Fourth Quarter and Year 2019"

[19] U.S. Census Foreign Trade Database, aggregated by WISER Trade.

While there may be some changes in import sourcing from our traditional trading partners (e.g., China) and some potential for shuffling markets for some manufactured goods, domestic demand is expected to rebound to pre-COVID19 levels within the next two to three years. As demand recovers and approaches its long-term growth rate and level, additional port and inland waterway capacity will be required.

Given these dynamics, now is an opportunity to make progress in addressing capacity issues by maintaining or increasing funding for improving port and waterways capacity. Doing so will ensure the U.S. is in a better position to provide competitive transportation services for exported commodities and maintain the ability to provide importers with efficient and cost-effective inland service.

5.1 Investment Gap for Coastal Ports and Inland Waterways

Investments in capital construction and major rehabilitation of both coastal and inland waterways rely on both private and public funding sources. Public funds are allocated to the U.S. Army Corps of Engineers (USACE) projects based on Congressional appropriations. Several funding sources are available for supporting these appropriations, but the major sources are the Harbor Maintenance Trust Fund (HMTF) and the Inland Waterways Trust Fund (IWTF).[20]

The HMTF is supported by a Harbor Maintenance Fee imposed on imports to the U.S. transported by ocean carriers and cruise ship passengers. The amount of HMF paid by ocean carriers is based on the value of cargo being imported; exports are prohibited from taxation under the U.S. Constitution. The Harbor Maintenance Fee funds the Harbor Maintenance Trust Fund that supports the USACE's coastal navigation projects. Since the HMTF is drawn primarily from the value of imports passing through U.S. marine ports, the forecast suggests that, at least in the near term, HMTF funding may fall short of recent expectations (Figure 6). The passage of the 2020 Water Resources Development Act, however, allows for the use of the unspent balance of $9.3 billion dollars in the HMTF by 2030.

The IWTF is funded by a $0.29 per gallon federal tax (Inland Waterways User Fee) on commercial barge fuel that is levied on commercial barge towing companies using inland and intracoastal waterways. The cost of inland waterways construction and major rehabilitation are shared through annual appropriations by the federal government and commercial users. Traditionally, the federal government contributed roughly 50% of the total and commercial users contributing their share through the IWTF, although Congress recently passed legislation that changes this cost share to be 65% federal funds and 35% IWTF. Funding for certain large projects such as the Olmstead Locks and Dam on the Ohio River and the Chickamauga Lock on the Tennessee River are addressed separately in authorizing legislation.

As part of the CARES Act, the Harbor Maintenance Trust Fund removes the spending cap, enabling Congress to appropriate the full amount of revenue collected from ad valorem shipper fees, and potentially allow these funds to be accessed sooner. This change will allow additional harbor maintenance funds to be available for dredging projects and harbor maintenance. The legacy of the cap is that the Harbor Maintenance Trust Fund still has a balance of $9.3 billion. With the passage of the CARES Act, $34 billion will be available over the next 10 years for harbor projects.

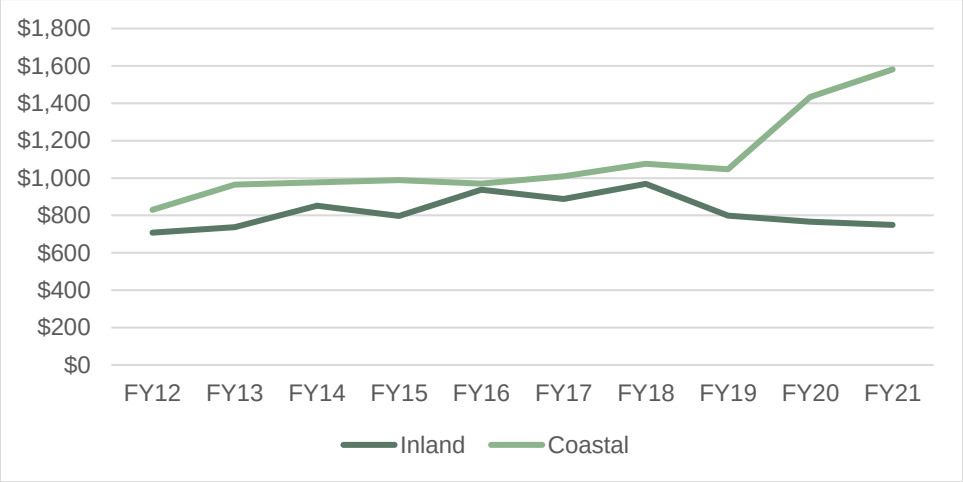
One new source of financing that stands to lessen the navigational investment gap was provided in the Water Infrastructure Finance and Innovation Act (WIFIA) in 2014. After a successful demonstration program, the USACE's Corps Water Infrastructure Financing Program (CWIFP) is in the process of being

[20] The IWTF is funded by the $0.29 per gallon federal tax (inland waterway user fee) on commercial- barge fuel on federally designated waterways.

implemented. CWIFP is designed to provide credit assistance to nonfederal sponsors for their portion of investments for projects that include navigation improvement. If appropriations are provided by Congress for CWIFP, USACE will be able to support eligible CWIFP-funded projects.

As Figure 7 shows, budgeted funding for inland and coastal navigation, which includes investigations, capital, and operations and maintenance expenditures, remained consistent through FY 2018 when inland funding dropped. Coastal budgets increased from $1 billion dollars in FY 2018 to $1.5 billion in FY 2021. Overall inland navigation funding (e.g. dredging and O&M) has been more consistent, although inland navigation funding also saw a decline in FY 2019. The actual funding from year to year varied, and when adjusted for inflation mostly was below the original assumed $1.078 billion annual budgets (from the prior two studies 2011 and 2016). In aggregate the actual funding for the period 2012 through 2020 was lower than the original estimates by $564 million for inland and up $744 million for coastal navigation.

Figure 7: Budgeted Navigation funding in Millions of Dollars for FY 2012 through FY 2021



Source: Fiscal Years 2012 -2021 Civil Works Budget for the U.S. Army Corps of Engineers.
Note: includes capital, investigations and operations and maintenance spending

This report looks at waterside infrastructure – i.e. navigational needs. It's important to acknowledge that ports and inland waterways have significant landside infrastructure funding gaps as well. Projects can include landside connections, port equipment, vessel berths, or terminal space. Some existing federal programs, including BUILD and FASTLANE, can help fund landside projects, including intermodal connectors and transfer facilities. In general, however, these programs are oversubscribed. A significant funding gap exists but due to the varied ownership of landside infrastructure, it is not covered below.

5.2 Funding Gap

The results of the updated analysis are shown in Table 3. This update modifies the original 2011 study methodology by adjusting the needs for inflation[21] and reflecting the additional funding that occurred prior to 2020. The forecasted navigation budgets for coastal and inland waterways were estimated using the

[21] Army Corps Federal Discount Rates for Project Formulation and Evaluation, Section 80 WRDA (Public Law 93-251).

historic median share of navigation budgets as a part of the total USACE's total construction budget from FY 2012 through FY2020.

The prior analysis assumed $1.078 billion per year in funding. When actual funding over the last decade was less than this threshold, it was reflected in the estimated funding need for 2020 through 2029 (e.g. more deferred future maintenance).

Funding estimates for 2030 through 2039 represent the median historic annual funding for each year for both inland waterways and coastal navigation. The median estimate was chosen as year-to-year funding varied especially considering the decline in funding in years FY 2019 and FY 2020. Additionally, these higher estimates account for new funding of coastal projects that may accrue due to the CARES ACT provision removing the HMTF spending cap in future years, and the 2020 Water Resources Development Act. The revised funding estimates for 2020 through 2029 highlight the recent increases in O&M navigation spending. These legislative actions in 2020, along with recent increases in funding, reduced the unfunded gap to $24.8 billion through 2029.

Table 3: Estimated Funding Need and Gap in Millions of Dollars for Navigation

	Estimated Need	Estimated Funding	Estimated Gap
2020-2029			
Inland Waterways	$19,570	$7,010	**$12,560**
Coastal Ports	$22,210	$9,960	**$12,250**
Total	**$41,780**	**$16,970**	**$24,810**
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2020-2039			
Total	$83,560	$34,940	$48,620

If authorized funding and budgets follow this trend, there will be a spending gap of just over $48 billion in unmet needs from 2020 through 2039.

6. Economic Impacts

The preceding section has summarized the gap between what investment is expected annually for coastal port and inland waterway transportation infrastructure and what will be needed to assure a

reliable transportation network for waterborne freight. This section explains the economic consequences of underinvestment that leads to significant delays in goods movement.

The failures to meet investment needs in marine ports and inland waterways will create channel depth limitations and lock and dam chamber operational inefficiencies. In turn, this will lead to increased cost to businesses due to more time and out of pocket costs required to transport commodities within the U.S., as well as between the U.S. and international markets. Shipment of goods will become more costly and time consuming. “On-the-clock” hours will increase, resulting in higher labor costs and other indirect costs, such as inventory delays associated with shipping.

Both domestic and international trade will be affected by the increased costs associated with sub-optimal performance of the waterways systems. Delays in domestic shipments due to inland waterway capacity limitations will primarily affect the energy and bulk commodity markets described in Section 3. In addition to growth in transit costs, delays and unreliable services will force shippers to hold greater inventory and plan for longer lead times for delivery. In turn, this will result in greater carrying costs. Each of these effects place additional costs on businesses that could otherwise be spending money more productively.

Increased costs for exports in the energy and agricultural sectors translate into less competitive pricing, which in turn harms our ability to retain and acquire international market share.[22] Since agricultural exports for a relatively large share of total U.S. agricultural output, even small changes in export costs can have important impacts on both producers and domestic spending on the many capital goods, raw materials and business services that support the agricultural sector. This is reflected in the overall economic impacts (direct and indirect) of reduction of agricultural exports due to trade policies as well as those due to increased cost associated with the poor performance of the inland waterways system.

This report examines the potential economic impacts of increased costs associated with underinvestment in the inland and coastal waterways system attributable to the long-term gaps identified in spending. By 2039, costs of waterborne shipping will increase on average 8% to 22% above costs in 2019 (Table 4). These increased supply chain costs will make U.S. products and services more expensive and less competitive or affordable, especially in export markets. Consequently, business income will fall, and employment will drop, and the aggregate wages and salaries earned by the U.S. workforce will decline. At the same time, the effects on the domestic market will mean that households will bear additional expenses of poor infrastructure as costs are passed on to consumers, especially in energy and construction materials markets. Combined, these cost-based business and household impacts have a ripple effect as sales shrink, thereby reducing employment and leading to further declines in business income and further cuts in worker income. Note that these costs do not include trucking costs associated with access to inland and coastal ports, which are part of the *Failure To Act Surface Transportation* analysis.

[22] See U.S. Department of Agriculture. Agricultural Trade Outlook and Trade at a Glance at: https://www.ers.usda.gov/topics/international-markets-us-trade/us-agricultural-trade/us-agricultural-trade-at-a-glance/

Table 4: Average Increased Cost of Waterborne Commerce, from 2019 to 2039

Freight Segment	Average Increased Cost	Segment of Freight System
Domestic-Inland	22%	Inland Waterways (locks, damns and associated infrastructure)
Exports	8%	Coastal Channels and Ports
Imports	17%	

Source: Calculations by EBP

6.1 Impacts to the U.S. Economy

Overall economic impacts of deficient waterborne freight transportation infrastructure are summarized in Table 5.

Table 5: Losses to U.S. Economy due to Worsening Water Freight Facilities ($2019 billions)

Year	Business Sales (Output)[23]	GDP	Disposable Income	Jobs
Losses in the Year 2029	$131	$73	$49	436,000
Losses in the Year 2039	$408	$219	$122	896,000
Cumulative Losses 2020-2029	$630	$366	$232	N/A
Cumulative Losses 2030-2039	$2,775	$1,502	$903	N/A
Cumulative Losses 2020-2039	$3,405	$1,868	$1,135	N/A

Columns may not add due to rounding. Note: Losses and increases reflect impacts in a given year against national baseline projections. These measures do not indicate declines from 2019 levels.
Sources: EBP and LIFT model, University of Maryland, INFORUM Group, 2020.

Direct losses imposed on businesses will accumulate over time as operations through marine ports and inland waterways become increasingly expensive for industries that rely on them. Economic slowdowns will be observed over the 2020-2029 period because facilities are expected to meet prevailing commercial needs, but these impacts will compound over the following decade if no actions are taken.

6.2 Total Economic Output and GDP

Without changes in investment for coastal port and inland waterway transportation infrastructure, business sectors across the nation are expected lose more than $3.4 trillion as a consequence of costs added to items shipped by water transportation compared to what would be supported with a modern and maintained locks, channels and coastal facilities. Our findings indicate that negative impacts will build

[23] Output represents gross production of U.S. industries. According the U.S. Bureau of Economic Analysis, gross output consists of both the value of what is produced and then used by other industries in production processes and the value of what is produced and sold to final users. Industry "value added" is defined as the value of the industry's sales to other industries and to final users minus the value of its purchases from other industries. Value added is a nonduplicative measure of production that when aggregated across all industries equals gross domestic product (GDP) for the economy.

slowly starting in 2020, but cascade in the second decade in this analysis. This might be explained as: (1) the escalation of cumulative effects, such as lower physical and human capital accumulation over the first 10 years that leave smaller capital stocks and less productive capacity in the later years even as excess costs continue to rise due to exceedingly outdated water transportation facilities; and (2) pushing shippers to choose between absorbing increasing annual costs associated with water transportation and passing these costs on to their customers. Choices are between lowering profits and cutting employment and other operating costs or raising prices to their customers. Either option results in making products less competitive and forcing business customers to also make choices between internal cost cutting and passing on price increases. These cycles will continue through many rounds of business sales. Ultimately, end users, whether consumers or businesses, will need to choose between paying the increased costs, finding lower cost substitution products, or "doing without."

Table 6 shows the total output losses by industry sector due to underinvestment in infrastructure from 2020 to 2029 and 2030 to 2039. Note, the 15 sectors shown in Table 6 and subsequent industry tables are consolidated from 64 industries within the LIFT model.[24]

Manufacturing is expected to account for $878 billion or 26% of all losses through 2039. Chief among threatened manufacturing industries are chemical products, and motor vehicles and other transportation equipment. Together, these sectors are projected to account for almost $470 billion, or 42% of the cumulative value of manufacturing losses through 2039.

The sectors encompassing finance, insurance and real estate, logistics and professional services are projected to account for an additional 37% of all losses through 2039, totaling almost $1.3 trillion between them. The significance of these sectors is that they provide services to companies that ship and receive goods due to coastal or inland water transportation. For example, about 23% ($289 billion) of losses among these sectors is expected to accrue to wholesale trade. Professional services, which are heavily oriented towards businesses are projected to account for 28% ($353 billion) of losses attributed to these three sectors. In addition, financial and real estate sectors provide services to both businesses and households (services that will be curtailed because of drops in disposable household income), are projected to lose $567 billion by 2039, or 45% of the total impacts attributed to these service sectors.

[24] The full concordance table of the industries shown to the full list of 64 are shown in the appendix.

Table 6: Aggregated Output Losses by Industry Sector ($2019 billions)

Sector	2020-2029	2030-2039	2020-2039
Manufacturing	$152	$726	$878
Health Care	$28	$142	$170
Professional Services	$65	$288	$353
Other Services	$55	$219	$274
Logistics	$59	$285	$344
Finance, Insurance and Real Estate	$109	$459	$567
Construction	$25	$85	$110
Retail trade	$19	$78	$98
Accommodation, Food and Drinking Places	$17	$65	$81
Transportation Services (excluding truck transportation)	$19	$79	$98
Mining, Utilities, Agriculture	$33	$137	$170
Information	$33	$148	$181
Educational Services	$6	$22	$28
Entertainment	$6	$24	$30
Social Assistance	$4	$18	$23
Totals	**$630**	**$2,775**	**$3,405**

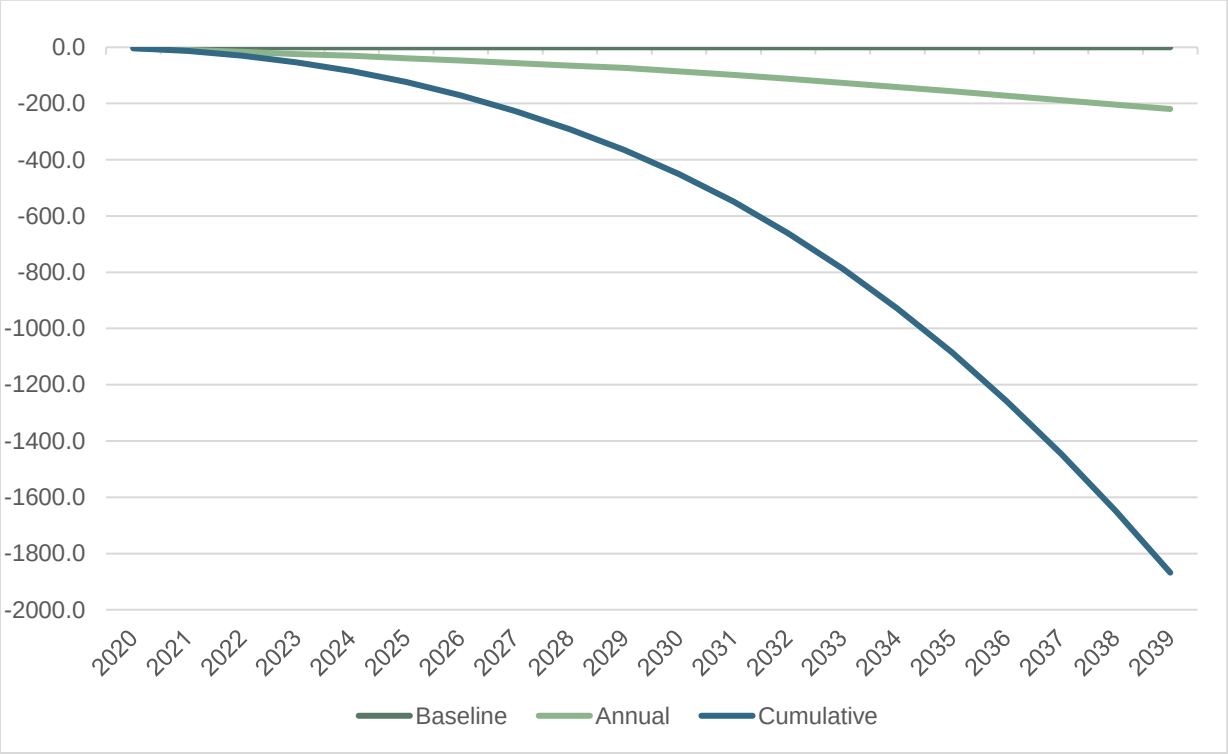
Columns and rows may not add due to rounding.
Note: Losses and increases reflect impacts in a given year against national baseline projections. These measures do not indicate declines from 2019 levels.
Sources: EBP and LIFT model, University of Maryland, INFORUM Group, 2020.

6.3 Gross Domestic Product

Failing to address congestion and reliability issues over the coming 20 years is expected to cost the national economy almost $1.9 trillion of GDP during that period. The cumulative economic effects from outdated water transportation facilities will escalate over time under present investment scenarios for inland water ways and seaport facilities. Costs of production and product delivery will increase as more dollars are needed for transportation services. As a consequence, prices will rise, and profit margins and sales will be curtailed as the excess transportation costs are either absorbed by businesses to retain market share or passed on the customers. These effects will result in businesses losing income and profits, production capacity falling (increasing imports and decreasing exports) and worker income declining, leaving less purchasing power among households.

Each of these dynamics will become worse from one year to the next. Lost GDP is expected to be $4 billion in 2020, $73 billion in 2029 and $219 billion in 2039. However, the total sum of annual losses over the 10-year period of 2020-2029 is predicted to be $366 billion. An additional $1.5 trillion of annual losses will be incurred from 2030 though 2039 as annual losses mount if investments in water transportation infrastructure continues on a trends-extended basis. Figure 8 illustrates the relationship of annual and cumulative losses of GDP from the national economy.

Figure 8: U.S. GDP Impacts 2020-2039 from the Gap in Marine Port and Inland Waterway Transportation Infrastructure Investment (billion 2019$)



Note: Losses reflect impacts in a given year against national baseline projections (shown as 0). These measures do not indicate declines from 2019 levels.
Sources: EBP and LIFT model, University of Maryland, INFORUM Group, 2020.

6.3 Disposable Income: Purchasing Power

Over the 20 year timespan of this analysis, U.S. households will lose an aggregate total of more than $1.1 trillion of disposable income in 2019 value. Each household in the U.S. stands to lose an average of more than $7,800 in disposable income aggregated across the 20 years. From 2020-2029, the average loss of disposable income is expected to be $1,700 per household ($170 per year). Over the next ten years, 2030-2039, disposable income per household is expected to decrease by an additional $6,200, or more than $600 per year on average.

Disposable income is what is used by households to purchase goods and services. Income reduction will lead to less consumption and/or purchases of cheaper goods. Lower levels of consumer purchases or substitution of less expensive goods will reduce demand and therefore lower industry output and GDP. As income falls over time, fewer goods and services will be purchased (or more purchases will be delayed), leading to even further drops in industry demand. The declining levels of household disposable income over time is shown in Table 7.

Table 7: Losses in Household Disposable Income Over Time

	Total ($2019 billions)	Per Household ($2019)
Annual		
2029	$49	$352
2039	$122	$815
Cumulative		
2020-2029	$232	$1,689
2030-2039	$903	$6,158
2020-2039	$1,135	$7,847

Notes: cumulative losses per household represent the total disposable income losses in each period presented divided by the average number of U.S. households projected for the years shown. Losses and increases reflect impacts in a given year against national baseline projections. These measures do not indicate declines from 2019 levels.
Sources: EBP and LIFT model, University of Maryland, INFORUM Group, 2020.

6.4 Employment Losses

An underperforming water transportation infrastructure will increase costs to businesses. Transporting goods will take more time, leading to unreliable delivery schedules and more expensive costs of goods. These changes will reduce competitiveness of national industries and result in less sales of products. With lower income, companies reliant on inland or coastal water freight will purchase less goods and services from suppliers, which in turn will modestly affect levels of employment across the U.S.

Given current investment practices, capital investment needs, and changing trends in demand, the national losses in employment amount to 436,000 jobs in the year 2029 and 896,000 jobs in 2039, which will represent one-half of one percent of the projected national job base that year (Table 8). Demand will exist for products and services, even as productivity declines and wages are lowered. Of note, the need for firms to lower costs by reducing employment is mitigated, in part, by the tendency for wage rates to fall as labor productivity weakens.

However, an important consideration is the mix of jobs. By 2039, the additional expenses incurred by shippers will cost 125,000 manufacturing jobs and an additional 114,000 jobs from goods movement logistics and transportation sectors from the national employment base. About 60% of the losses projected for manufacturing jobs are in the industries of chemicals products including pharmaceuticals, transportation including motor vehicles, metals, machinery and electronics. These are among the highest paying sectors for labor, and these sectors also include significant research and development branches that are important for continually strengthening U.S. technology. Moreover, the loss of disposable income will lower discretionary household spending for health care as well as retail, accommodations and restaurants, and entertainment resulting in job losses in those sectors. Losses in both household and business income will lead to losses in services and construction.

Table 8: Potential Employment Losses because of inadequate Inland and Coastal Water Transportation infrastructure, 2029 and 2039

Sector	2029	2039
Manufacturing	53,000	125,000
Finance, Insurance and Real Estate	27,000	52,000
Professional Services	38,000	80,000
Other Services	61,000	115,000
Health Care	63,000	147,000
Construction	24,000	46,000
Information	8,000	14,000
Logistics	34,000	88,000
Retail trade	32,000	58,000
Mining, Utilities, Agriculture	14,000	33,000
Transportation Services (excluding truck transportation)	12,000	26,000
Accommodation, food and Drinking Places	28,000	41,000
Entertainment	10,000	17,000
Educational Services	20,000	35,000
Social Assistance	13,000	19,000
Totals	**436,000**	**896,000**

Columns may not add due to rounding.
Note: Losses and increases reflect impacts in a given year against national projections. These measures do not indicate declines from 2019 levels
Sources: EBP and LIFT model, University of Maryland, INFORUM Group, 2020.

6.5 Less Competitive in International Markets

The worsening condition of coastal ports and movements on inland waterways that connect coastal ports with inland markets are predicted to lower the value of international trade by about $1.5 trillion cumulatively over 20 years, $904 billion less in exports and $578 billion less in imports. Overall, the net reduction in the national balance of trade will be about $327 billion. As noted from the discussions of job losses and output, U.S. manufactured products and agricultural exports will be less competitive in international markets due to the added costs of transportation. Moreover, reductions in imports mean that the U.S. will have less access to worldwide markets that compete with each other to provide lower cost and timely deliveries of commodities; as a result, businesses and households will pay higher costs for intermediary and final use commodities and products.

Table 9 shows the cumulative trade effects by quantifying the degree to which exports and imports are expected to decrease compared to forecast trade baselines. By 2029, exports and imports are expected to show aggregate losses of approximately $159 billion and $105 billion, respectively, in 2019 dollars. In the year 2039 alone, the losses are predicted to be $116 billion in exports and $73 billion in imports, amounting to $43 billion addition to the national trade deficit due the economic costs imposed by failing to address investment shortfalls.

Table 9: Cumulative Trade Effects ($2019 billions)

Period	Cumulative Export Losses	Cumulative Import Losses	Total Trade Losses
2020-2029	$159	$105	$264
2030-2039	$745	$472	$1,218
2020-2039	$904	$578	$1,482

Columns and rows may not add due to rounding. Losses and increases reflect impacts in a given year against total national export projections. These measures do not indicate declines from 2019 levels.
Sources: EBP and LIFT model, University of Maryland, INFORUM Group, 2020.

The LIFT model traces 121 goods and services commodities, including commodities sold by U.S. companies to international markets. Table 10 lists the 15 exported goods and services that stand to lose the most money through 2020 and 2039 as consequences of aged water transportation infrastructure. The table is presented in order of cumulative losses in in exports through 2039 (in 2019 dollar value), and also shows losses from 2020-2029 and 2030-2039. Note that in addition to wholesale trade, manufacturing accounts for nine sectors, including technology-based aerospace, motor vehicles and pharmaceuticals. Overall, manufacturing sectors are expected to lose $467 billion over 20 years because the additional time and expense required for using inefficient coastal ports will render U.S. products less competitive on cost and time-of-delivery basis with international competitors. In addition to manufacturing, two sectors that stand to lose significant money are extraction commodities, and three are from the nation's agriculture and food producers.

Table 10: Potential U.S. Export Reductions in Goods and Services by 2029 and 2039, Ten Largest Affected Sectors ($2019 billions)

Export Sector	2020-2029	2030-2039	2020-2039
Wholesale trade	$21	$120	$141
Aerospace products and parts	$11	$50	$61
Other chemicals	$8	$41	$49
Motor vehicles	$5	$20	$24
Motor vehicle parts	$4	$20	$24
Resin, synthetic rubber and fibers	$4	$19	$23
Petroleum and coal products	$7	$15	$21
Crop production	$3	$17	$20
Crude oil extraction	$4	$16	$19
Pharmaceuticals	$4	$15	$19
Other foods	$3	$15	$18
Dairy products, meat and seafood	$3	$15	$18
Nonferrous metals	$3	$14	$17
Fabricated metal products	$2	$14	$16
Other general-purpose machinery	$3	$14	$16

Note: Changes reflect impacts in a given year against national baseline projections by year from 2020 through 2039. These measures do not indicate changes from 2019 levels. Totals for pharmaceutical products

and other chemicals are the sums of two commodity groups, "Pharmaceutical products" and "Other chemicals".
Sources: EBP and LIFT model, University of Maryland, INFORUM Group, 2020.

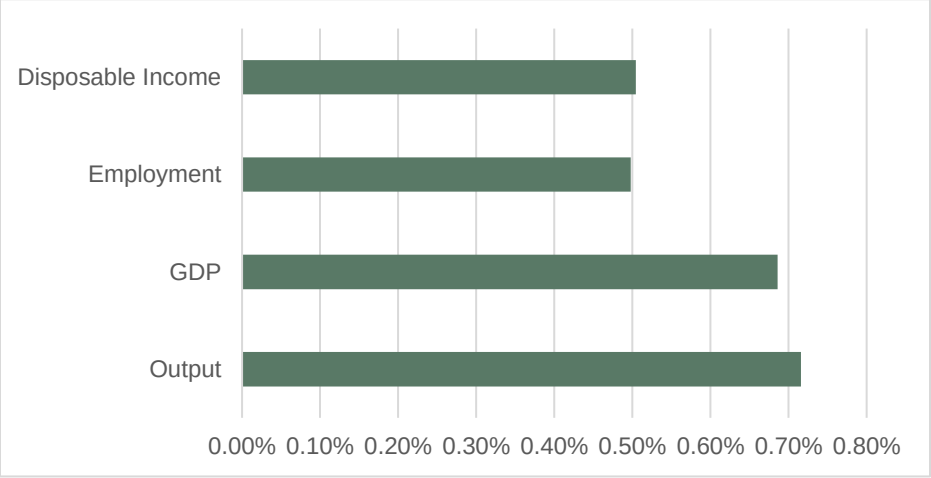
7. Conclusion

Overall 1.9 trillion tons are transported through U.S. coastal ports and along the nation's system of inland rivers and the Great Lakes.[25] Coastal ports are the primary means that goods move between the U.S. and international markets and inland waterways are inexpensive means to transport goods within the U.S. both to domestic markets and to coastal ports for export.

Time associated with goods movement will increase if ports, coastal channels, locks and dams are not modernized to service the current sizes and technologies of vessels and to meet anticipated volumes of shipping. As discussed in this analysis, increased shipment time will incur costs for U.S. businesses in labor and also due to delays in deliveries, inventory management and supply chain dynamics. Additionally, U.S. businesses will be restricted in their ability to take full advantage of worldwide competitive pricing when sourcing input commodities for production processes. Overall, without increased investment, costs of production will rise because material transported over water will increase. These costs will either be absorbed by business or passed on to customers.

More than other infrastructure sectors in the Failure to Act series, the industries that are directly affected are traditional manufacturing industries, along with agriculture production and extraction. These are the sectors that support a diversified national economy and contribute to a favorable balance of trade.

Figure 9: Anticipated Impacts of Aged Port and Inland Waterway Infrastructure on U.S. Economy in 2039



Source: INFORUM and EBP

Because 80% of losses are anticipated to be experienced from 2030 through 2039, there is time to address the identified cost impacts. From 2020-2029, $366 billion in GDP is expected to be lost from the U.S. economy, while an additional $1.5 trillion is expected to be lost in the following decade. Importantly, given the lead time necessary to plan, appropriate and commit funding for major projects, there is some urgency to maintain – if not increase – the funds needed to bring capacity and operational improvement projects "on-line" within the next 10 years.

[25] Sources are the Freight Analysis Framework of the Bureau of Transportation Statistics and Federal Highway Administration and the U.S. census Bureau Foreign Trade Division, assembled by WISERTrade.

Appendix: Primary Sector Definitions

Primary Sector	Sub-sectors
Manufacturing	Food and beverage and tobacco products, Textile mills and textile product mills, Apparel and leather and allied products, Wood products, Paper products, Printing and related support activities, Petroleum and coal products, Chemical products, plastics and rubber products, Nonmetallic mineral products, Primary metals Fabricated metal products, Machinery, Computer and electronic products, Electrical equipment, appliances and components, Motor vehicles, bodies and trailers and parts, Other transportation equipment, Furniture and related products, Miscellaneous manufacturing
Health Care	Ambulatory health care services, Hospitals, Nursing and residential care facilities
Professional Services	Legal services, Miscellaneous professional, scientific and technical services, Computer systems design and related services, Management of companies and enterprises
Other Services	Administrative and support services, Waste management and remediation services, Other services, except government, Civilian government
Logistics	Wholesale trade, truck transportation, Warehousing and storage
Finance, Insurance and Real Estate	Federal Reserve banks, credit intermediation, and related activities, Securities, commodity contracts, and investments, Insurance carriers and related activities, Funds, trusts and other financial vehicles, Housing services, Other real estate, Rental and leasing services and lessors of intangible assets
Construction	Construction
Retail trade	Retail Trade
Accommodation, food and Drinking Places	Accommodation, Food services and drinking places
Transportation Services (excluding truck transportation)	Air transportation, Rail transportation, Water transportation, Transit and ground passenger transportation, Pipeline transportation, Other transportation and support activities
Mining, Utilities, Agriculture	Farms, Forestry, fishing and related activities, Oil and gas extraction Mining, except oil and gas, Support activities for mining, Utilities
Information	Publishing industries, except internet (includes software), Motion picture and sound recording industries, Broadcasting and telecommunications, Data processing, internet publishing and other information services
Educational Services	Educational services
Entertainment	Performing arts, spectator sports, museums and related activities, Amusements, gambling and recreation industries
Social Assistance	Social assistance