



Balancing Infrastructure Demands: Analysis of Materials Pricing and Supply

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Kentucky Transportation Center
College of Engineering, University of Kentucky, Lexington, Kentucky

in cooperation with
Kentucky Transportation Cabinet
Commonwealth of Kentucky

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Research Report

KTC-25-17

Balancing Infrastructure Demands: Analysis of Materials Pricing and Supply

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16. Abstract The Kentucky Transportation Cabinet (KYTC) lets around 700 contracts year valued at over \$1 billion. One of KYTC's foremost goals is to deliver projects on time and on budget. However, over the past five years achieving these twin goals has grown in difficulty due to material shortages, widespread inflation, supply chain disruptions, and the tight labor market triggered by the COVID-19 pandemic. Although material shortages have abated and supply chain disruptions have eased, instability is seemingly a permanent feature of the national and global economies. As such, Cabinet decision makers need reliable tools that can be used to understand historical trends in material pricing and forecast future short-term variability in commodities markets. Equipped with this information, KYTC can proactively devise and implement strategies to mitigate future impacts of price increases and supply chain disruptions. To arm the Cabinet with the data it needs to make judicious investment and program management decisions, Kentucky Transportation Center (KTC) researchers have developed two Tableau-based dashboards — a <i>Unit Bid Dashboard</i> and a <i>National Commodity Trends Dashboard</i>. These dashboards house historical pricing data for essential highway construction inputs both at the state and national levels and give users the ability to develop one-year price forecasts. To ensure these dashboards play a role in future decision making, they should be updated regularly.				
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Section 1 Introduction

Each year the Kentucky Transportation Cabinet (KYTC) awards roughly 700 contracts valued at over \$1 billion. Alongside a sprawling project development and delivery program, the agency manages an infrastructure asset portfolio that consists of over 27,500 roadway miles and 14,000 bridges. Balancing asset management and project delivery is a complex and expensive task. One which over the past five years has grown more challenging as KYTC and its industry partners have navigated rising material prices, many stemming from material shortages and erratic supply chain dynamics triggered by the COVID-19 pandemic.

Material shortages and other disruptions that result in price adjustments are generally handled via change orders after projects are awarded. With material shortages and supply chain disruptions poised to become a regular feature of the economic landscape, the Cabinet must identify reliable strategies to negotiate material scarcity, increased prices, and a growing demand for projects. To mitigate issues with material shortages and climbing costs, KYTC needs to understand the implications of workforce availability as well as material constraints and pricing. Using historical data and knowledge of how materials-related issues have impacted budgets, delivery timelines, and the emergence of unforeseen impacts at the level of individual projects and programmatically will help the Cabinet negotiate continually evolving and sometimes unpredictable business environments. Integrating historical knowledge on these issues into decision making will help the Cabinet spot potential trends, coordinate resources, and collaborate with industry partners.

1.1 Research Objectives

- Investigate and evaluate approaches used by other state transportation agencies (STAs) to manage supply chain issues.
- Develop analytical strategies KYTC can use to evaluate how issues related to material supplies and pricing influence delivery of the Six-Year Highway Plan.
- Identify best practices and insights for proactively addressing future issues.

Table 1.1 Report Structure

Chapter	Material
2	• Literature review covering supply chain topics and STA approaches for dealing with material shortages and supply chain issues.
3	• Present an overview of two dashboards — a <i>Unit Bit Dashboard</i> and a <i>National Commodity Trends Dashboard</i> — KYTC can leverage to understand historical pricing trends and forecast future prices.
4	• Concluding thoughts and next steps.

Section 2 Literature Review and Background

Supply chains were an often-unnoticed feature of the global economy until the COVID-19 pandemic caused massive disruptions and shortages of goods (Sheffi 2023). Supply chains begin to fracture when inputs into one or more steps of production processes (e.g., labor and materials) are unavailable or cannot be procured in a timely manner. On-time delivery of road projects depends on critical inputs being readily available (e.g., asphalt, rock, steel, heavy equipment, workers) and is thus sensitive to supply chain disruptions.

While intuitively we know that road projects undertaken during the height of the pandemic confronted unprecedented challenges, unfortunately the literature on the pandemic’s precise impacts on STA project delivery is as predictable as it is empirically thin. While transportation-oriented case studies situated in Sub-Saharan Africa, Asia, and other parts of the world proliferate, not much has been done within the US context. Synthesizing a vast body of literature on COVID-19’s impacts on the construction industry broadly, Adepu et al. (2024) found that many construction projects faced schedule and cost overruns due to volatility in material costs, diminished reliability of supply chains, transportation disruptions, altered trade flows due to border closures, higher freight movement costs, and difficulty procuring heavy equipment. They recommended a few strategies to mitigate supply chain–related disruptions in the future, including diversifying supplier networks, boosting reliance on local suppliers, establishing contingency plans in case of future disruptions or material shortages, inserting price escalation clauses into contracts, and being proactive in adopting new construction practices that may reduce exposure to disruptions. Ilatova et al. (2022) reported on a 2021 survey of construction contractors in New York State that found 81 percent had encountered project delays due to material shortages or longer lead times for material acquisition. Shaker et al. (2024) offered a more grounded case study focused on project impacts encountered by the Connecticut Department of Transportation (DOT). The agency saw increased delays and costs due to material shortages, with the effects being most pronounced on bridge replacements, facility renovations, and highway signage installation projects. In a narrower study focused on how the effects of COVID-19 reverberated through the price of reclaimed asphalt concrete in the State of Georgia, Paik et al. (2024) detected an upward shift in prices beginning 2021, coinciding with a period of sustained inflation that lasted for over two years.

Findings highlighted in these case studies are consistent with changes observed in the Federal Highway Administration’s (FHWA) National Highway Construction Cost Index (NHCCI), which tracks price fluctuations in highway construction inputs. Table 2.1 summarizes NHCCI fluctuations from 2018 through the first half of 2024. The third column — labeled *NHCCI* — indicates the year-over-year change in the index. For example, in the second quarter of 2024, the NHCCI was 6.5 percent higher than in the second quarter of 2023. The most dramatic year-over-year increases in the index were concentrated in late 2021 through the second quarter of 2023. Rows shaded green in Table 2.1 indicate year-over-year changes in the NHCCI exceeding 10 percent during the COVID-19 era. Although we cannot plausibly claim that material shortages account entirely for the sharpest upward changes in the NHCCI, they occurred when supply chains were most disrupted and certainly contributed.

Table 2.1 National Highway Construction Cost Index (2018 – 2024)

Year	Quarter	NHCCI	PPI All Commodities	CPI All Items	PPI Asphalt	PPI Fabricated Structural Metal	PPI Paving Mixtures and Blocks
2018	1	3.60%	4.00%	2.20%	16.30%	5.90%	3.50%
	2	4.00%	4.90%	2.70%	22.10%	11.00%	4.70%
	3	6.40%	5.00%	2.60%	50.40%	13.40%	8.70%
	4	12.70%	3.50%	2.20%	43.90%	13.00%	10.40%
2019	1	10.40%	0.40%	1.60%	20.30%	9.80%	5.70%

	2	11.60%	-0.60%	1.80%	14.90%	1.60%	5.40%
	3	6.90%	-2.10%	1.80%	-3.60%	1.10%	1.90%
	4	2.60%	-1.90%	2.00%	-17.10%	-2.30%	-1.10%
2020	1	6.50%	-1.70%	2.10%	-6.30%	-2.80%	1.00%
	2	0.50%	-6.40%	0.40%	-40.10%	-2.90%	-3.70%
	3	-4.20%	-2.60%	1.20%	-33.40%	-2.50%	-5.70%
	4	-3.30%	-0.20%	1.20%	-25.00%	-0.90%	-3.70%
2021	1	-2.90%	7.00%	1.90%	-2.20%	4.00%	0.10%
	2	3.60%	18.80%	4.80%	65.00%	20.50%	1.80%
	3	11.50%	20.30%	5.30%	53.70%	37.00%	5.70%
	4	17.30%	21.80%	6.70%	73.80%	45.40%	7.20%
2022	1	19.50%	20.40%	8.00%	42.90%	48.40%	8.50%
	2	25.50%	21.90%	8.60%	64.60%	38.90%	17.30%
	3	32.00%	15.50%	8.30%	59.20%	20.10%	22.30%
	4	27.60%	8.40%	7.10%	9.40%	10.80%	18.90%
2023	1	24.50%	2.20%	5.80%	-20.30%	3.50%	14.00%
	2	16.20%	-6.60%	4.00%	-31.20%	-3.50%	5.50%
	3	12.50%	-4.80%	3.50%	-32.50%	-2.60%	-1.50%
	4	11.90%	-3.60%	3.20%	-10.10%	1.00%	0.90%
2024	1	12.20%	-1.90%	3.20%	10.70%	-1.80%	2.10%
	2	6.50%	0.50%	3.20%	4.60%	-9.60%	2.60%

Source: FHWA (2024)

Beyond the case studies cited above, the literature on STA response and management to supply chain delays and price increases is quite limited, but some federal reviews provide insights. President Biden issued Executive Order 14017¹ in 2021, which prescribed a review of supply chain risks in order to strengthen resiliency. FHWA and the US Department of Transportation (USDOT) both examined this issue. FHWA released an overview of how construction quality assurance at STAs is impacted by challenges such as price increases, supply chain issues, and labor shortages (FHWA 2025). USDOT's (2022, p. xi) report identified ongoing challenges related to supply chains:

- Growing freight demand
- Changing consumer preferences, including demand for rapid delivery
- Attracting, training, and retaining a qualified workforce
- Increasingly complex, global supply chains where many products are manufactured abroad
- Increased disruptions caused by extreme meteorological events
- Adapting to new technology while maintaining security

The report also pinpointed other challenges such as data accessibility and its impact on supply chains, congestion, infrastructure condition, and security (including cybersecurity). The US, the report argued, should focus on building more resilient supply chains that are redundant, flexible, and adaptable. Here, resiliency refers to a system's ability to maintain reliable service and responsiveness in the face of disruptions. Policy responses identified in the report

¹ <https://www.presidency.ucsb.edu/documents/executive-order-14017-america-s-supply-chains>

include investing in infrastructure to support freight movement, providing support and expertise to assist with planning investments and workforce support, improving data and research on supply chain effectiveness, and working with stakeholders to improve coordination. The report also identifies several policy goals and recommendations to support those goals, evaluating the complexity, cost, time to implement, and modes of transportation they would impact.

The National Governor’s Association (NGA) issued a white paper state-level responses to supply chain issues (2023). It observed that “supply chain issues in the infrastructure and transportation sector are primarily related to physical bottlenecks that hinder the movement of supplies on major transportation routes and distribution centers, including ports” (p. 5). As part of *The Infrastructure Investment and Jobs Act (IIJA)*, or *Bipartisan Infrastructure Law (BIL)*, governors were asked to designate an infrastructure coordinator to better manage the influx of federal funding. On the topic of infrastructure and transportation supply chains, the paper uses Michigan and Maryland as examples — the Michigan Infrastructure Office was created to coordinate with federal, state, and local stakeholders; Maryland invested in the Port of Baltimore to improve the movement of goods. USDOT’s Inspector General issued a memo (Soskin 2022) outlining challenges related to IIJA implementation. This memo highlighted familiar themes such as maintaining an adequate workforce, engaging and coordinating with stakeholders, and managing price increases and goods shortages. The Bureau of Transportation Statistics noted that higher costs could reduce the purchasing power of IIJA funding up to 40 percent over five years, if construction costs grow at the same rate as in 2019 and 2021.² Other scenarios with more modest construction inflation could still reduce purchasing power by over 30 percent, assuming costs grow at the same rate as in 2021 and 2022. Figure 2.1 illustrates these scenarios, where inflation is measured by the NHCCI.³

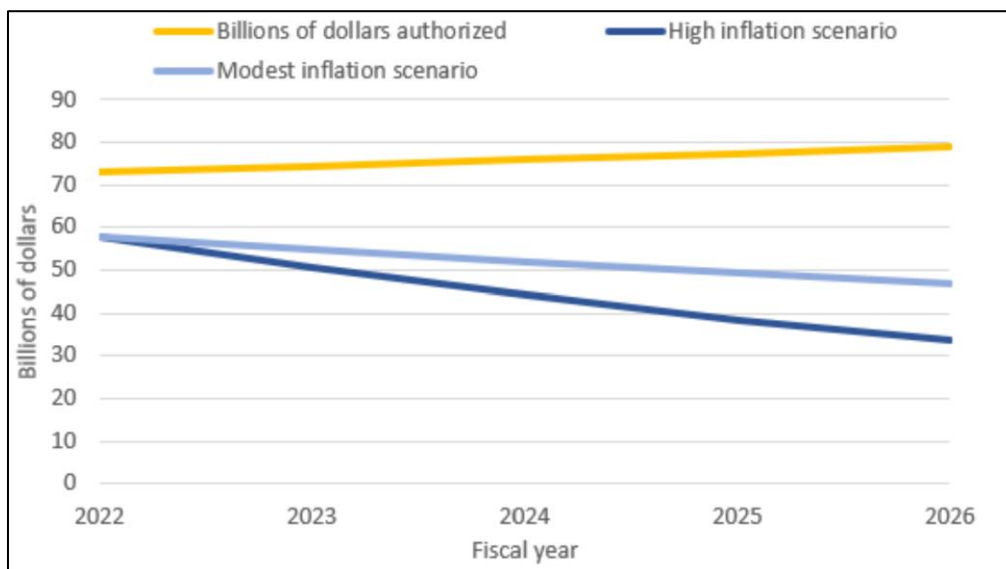


Figure 2.1 Impacts of Inflation on IIJA Funding⁴

² <https://www.bts.gov/data-spotlight/increases-highway-construction-costs-could-reduce-iija-funding-allocated>

³ <https://data.bts.gov/stories/s/9kj8-x76q/>

⁴ From Bureau of Transportation Statistics, <https://www.bts.gov/data-spotlight/increases-highway-construction-costs-could-reduce-iija-funding-allocated>

Other challenges facing STAs include *Build America, Buy America* (BABA) requirements. The IIJA made changes to the Buy America requirements for federally funded infrastructure projects, including roads and bridges.⁵ Buy America first impacted transportation projects as part of the *Surface Transportation Assistance Act of 1978*. Traditionally, Buy America requirements focused on iron, steel, and other select manufactured goods. These IIJA expanded these requirements, with Section 9014 reading:

The head of each Federal agency shall ensure that none of the funds made available for a Federal financial assistance program for infrastructure, including each deficient program, may be obligated for a project unless all of the iron, steel, manufactured products, and construction materials used in the project are produced in the United States.⁶

Executive Order 14005⁷ (*Ensuring the Future is Made in All of America by All of America's Workers*) established a Made in America Office in the Office of Management and Budget (OMB) to verify compliance with Buy America requirements and review waiver requests. As part of the IIJA, requirements for manufactured products as defined by OMB now also include: “nonferrous metals, such as copper used in electric wiring; plastic- and polymer-based products; glass, including optical fiber; and certain other construction materials, such as lumber and drywall.”⁸ Implementation guidance notes that “an article, material, or supply should only be classified into one of the following categories: (1) iron or steel; (2) a manufactured product; or (3) a construction material. For ease of administration, an article, material, or supply should not be considered to fall into multiple categories.”⁹ To meet the IIJA’s BABA requirements, goods must have domestically sourced content greater than 55% and be manufactured in the US. OMB issued a notice that helps businesses and agencies differentiate between the costs of components purchased by a manufacturer versus those produced by a manufacturer. If a manufacturer purchases components, the total cost includes acquisition cost (e.g., inclusive of transportation and duties). But if they produce them, total costs include everything needed for production, including overhead costs that can be allocated.

BABA waivers are available if materials are not produced in either the necessary quantities or quality in the US, costs increase past a certain threshold, or requirements conflict with the public interest. Prior to granting a waiver, the IIJA directs the Secretary of Transportation to work with the Secretary of Commerce in consultation with the Director of the Hollings Manufacturing Extension Partnership to verify the material in question cannot be produced domestically. This directive also instructs all federal agencies to help identify domestic firms that can supply materials that meet the Buy America requirements. Before a waiver is approved, it must be posted publicly for public comment. General applicability waivers have a five-year review requirement, including a review to verify a waiver based on cost is not needed due to unfair trade practices. The Commerce Department keeps a list of approved waivers.¹⁰

⁵ <https://www.hud.gov/sites/dfiles/GC/documents/Build%20America,%20Buy%20America%20Act%20Provisions.pdf>

⁶ <https://www.congress.gov/bill/117th-congress/house-bill/3684/text>

⁷ <https://www.federalregister.gov/documents/2021/01/28/2021-02038/ensuring-the-future-is-made-in-all-of-america-by-all-of-americas-workers>

⁸ <https://crsreports.congress.gov/product/pdf/IF/IF11989>

⁹ <https://www.federalregister.gov/documents/2022/11/15/2022-24743/notice-that-the-build-america-buy-america-requirement-for-construction-materials-applies-effective>

¹⁰ <https://www.commerce.gov/oam/build-america-buy-america>

Section 3 Materials Pricing Dashboards

To give KYTC a clear picture of long-term trends and short-term fluctuations in material pricing since 2011, our team developed two Tableau dashboards¹¹ — a *Unit Bid Dashboard* and a *National Commodity Trends Dashboard*. The *Unit Bid Dashboard* is populated with KYTC unit bid data from 2011 to 2024 and includes price and quantity specific dashboards. To improve the dashboard’s functionality and ability to generate usable information, unit bid items were grouped into 16 broad item classes:

- Asphalt
- Asphalt-Related Items
- Bridge Maintenance
- Concrete Pavement
- Curbs and Roadside
- Drainage
- Earthwork
- Erosion Control
- Guardrail
- Pavement Markings
- Permanent Traffic Control
- ROW and ROW Fence
- Slope Protection
- Structures
- Temporary Traffic Control
- Utilities and Rail

On the front page of the *Unit Bid Dashboard* shown in Figure 3.1, users can filter by item class as well as item by descriptions and deviations (positive and negative) from the annual median unit bid price. By default, the dashboard displays data for all years, however, users can also display data for individual years.

¹¹ Data visualization software: <https://www.tableau.com/>

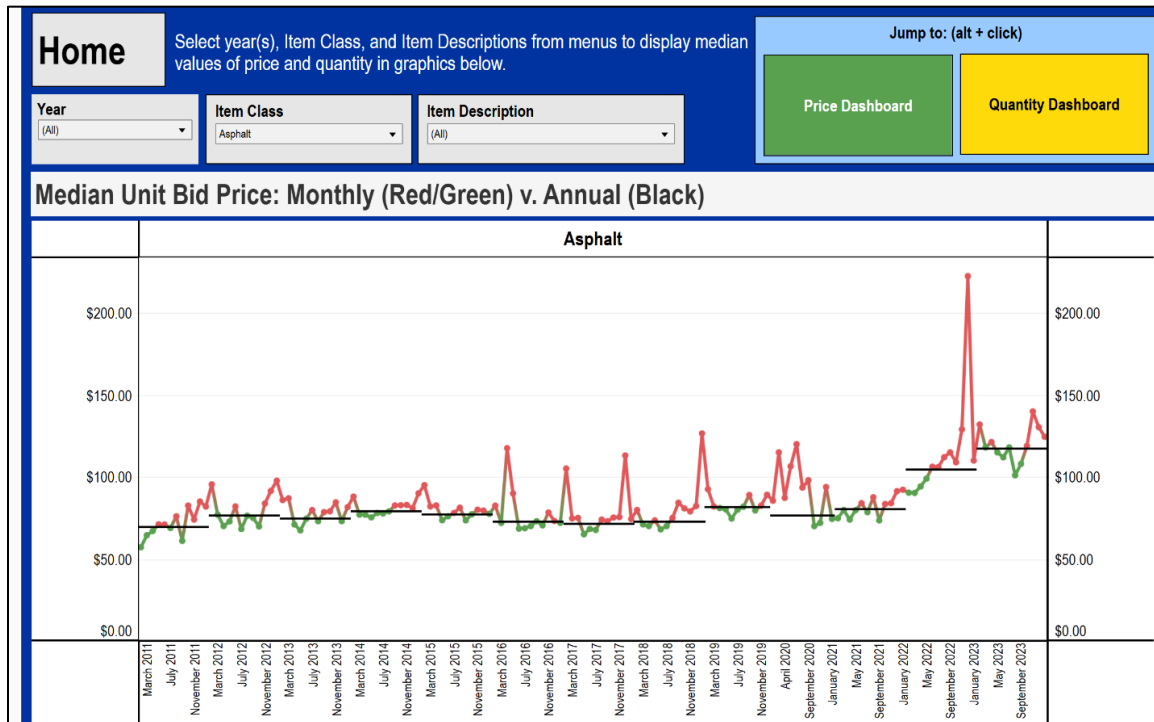


Figure 3.1 Unit Bid Dashboard

Both price and quantity for selected item class(es) can be viewed with a dual axis, helping users to locate fluctuations, as shown in Figure 3.2.

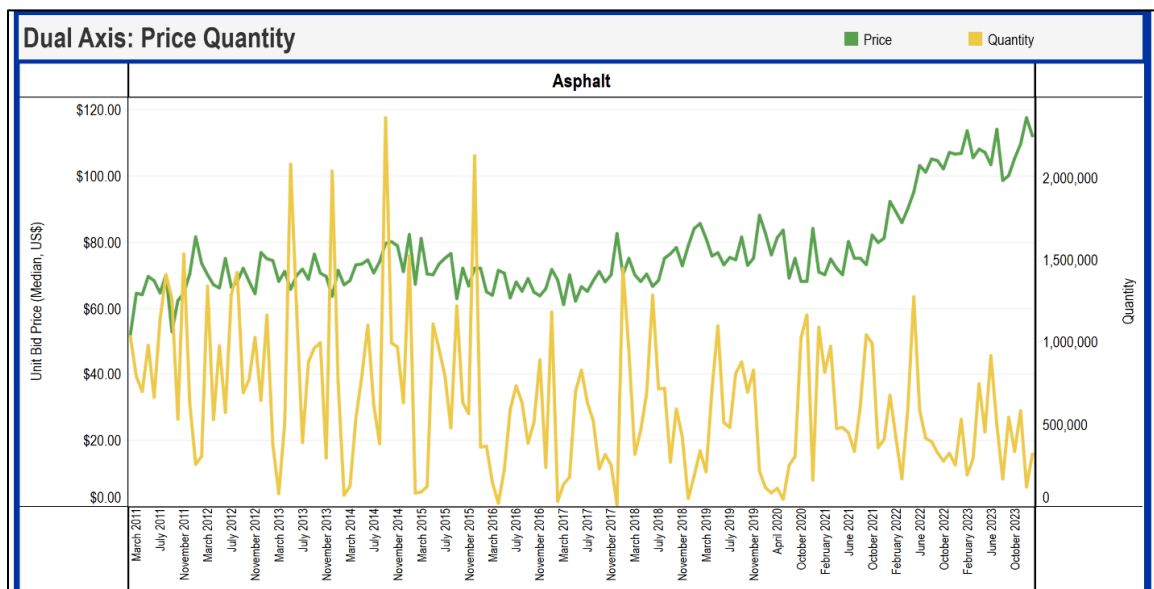


Figure 3.2 Unit Bid Dashboard Dual Price and Quantity Axis

Users can also examine price and quantity individually across regions (North, South, East, and West). These regions match KYTC’s project prioritization regions used in SHIFT.¹² For quantities, total quantity is shown by letting data (Figure 3.3). Letting dates and total quantity can be adjusted to pinpoint individual project anomalies, while regions, item class, and item description can be filtered. Additional quantity details are provided for each contract with a project work description, an item description and then the total (Figure 3.4)

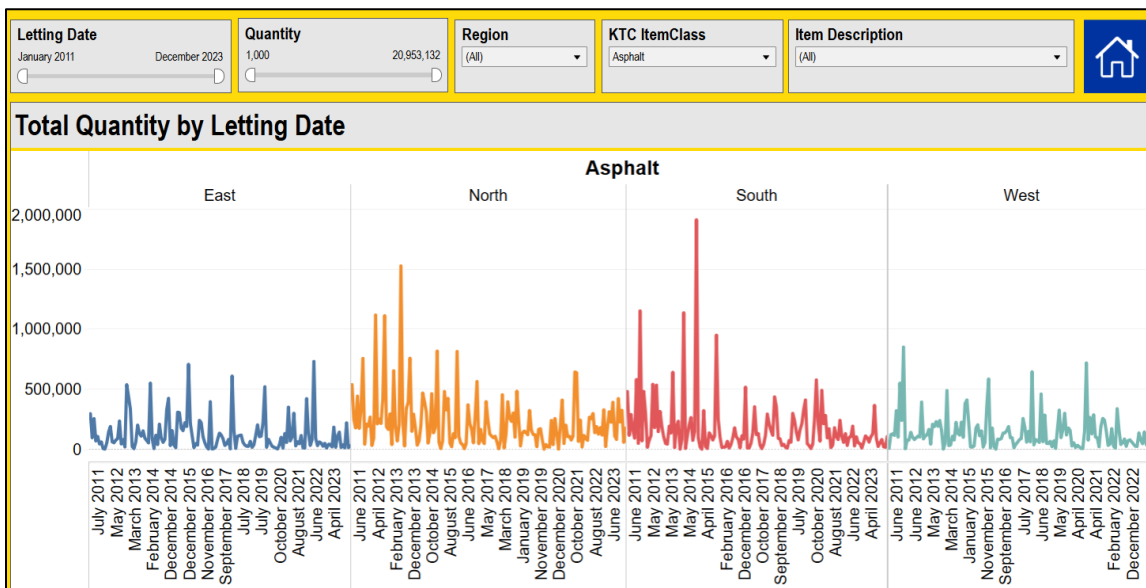


Figure 3.3 Quantity Dashboard

Quantity Details				
	Contract ID	Project Work	Item Description	Asphalt
1/28/2011 North	111001	RECONSTRUCT KY 16 (TAYLOR MILL ROAD) FROM KLEET ROAD TO	CL2 ASPH BASE 0.75D PG64-22	7,396 (TON)
			CL2 ASPH BASE 1.00D PG64-22	27,090 (TON)
			CL2 ASPH SURF 0.38B PG64-22	3,489 (TON)
			CL2 ASPH SURF 0.38D PG64-22	1,587 (TON)
	111002	RECONSTRUCT I-265/US 60 INTERCHANGE TO ENHANCE CAPACITY AND	CL2 ASPH BIND 0.50D PG64-22	1,723 (TON)
			CL3 ASPH BASE 0.75D PG64-22	7,666 (TON)
			CL3 ASPH SURF 0.38D PG64-22	1,281 (TON)
			CL4 ASPH BASE 0.75D PG76-22	8,637 (TON)

Figure 3.4 Quantity Dashboard — Quantity Details

¹² <https://transportation.ky.gov/SHIFT/Pages/default.aspx>

Price shows average unit bid price by region and letting dates (Figure 3.5) The price default also shows forecasted prices for one year. Letting dates can be adjusted to pinpoint individual project anomalies, while regions, item class, and item description can be filtered like the Quantity Dashboard. Additional price details are provided for each bidder by item description with details on the contract ID and project description also available (Figure 3.6).

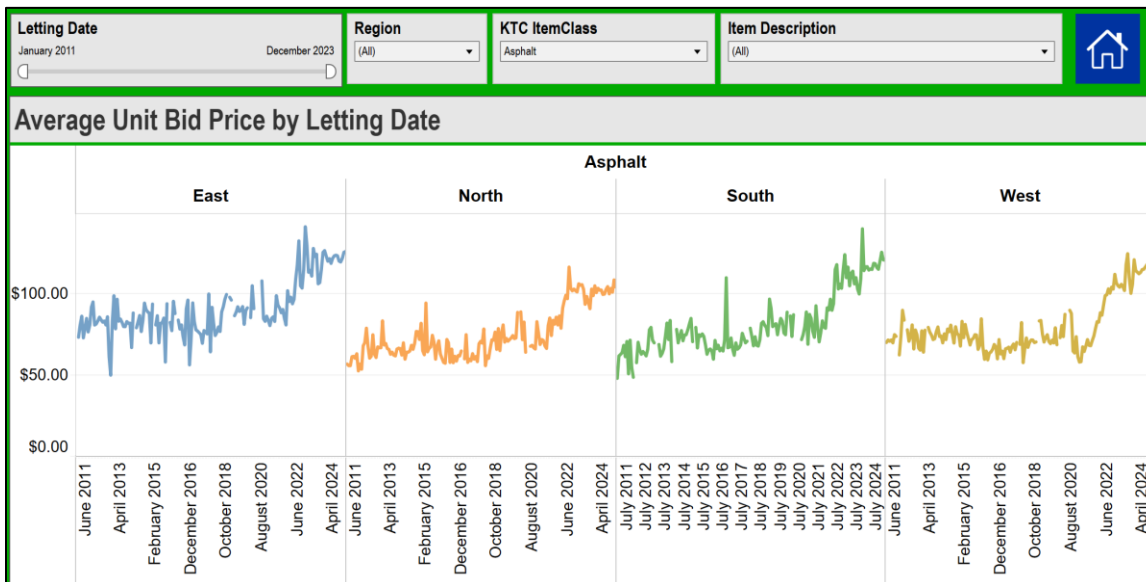


Figure 3.5 Price Dashboard

Unit Bid Price Details				
Contract ID	Project Work	Item Description	Bidder	Asphalt
111004	RECONSTRUCT KY 89 FROM THE IRVINE BYPASS TO 2000' NORTH OF	CL2 ASPH BASE 1.00D PG64-22	Bidder1	\$56.95
			Bidder2	\$56.95
			Bidder3	\$56.95
			Bidder4	\$56.95
			Bidder5	\$56.95
			Bidder6	\$56.95
		CL2 ASPH SURF 0.38B PG64-22	Bidder1	\$74.50
			Bidder2	\$74.50
			Bidder3	\$74.50
			Bidder4	\$74.50
			Bidder5	\$74.50
			Bidder6	\$74.50

Figure 3.6 Price Dashboard — Unit Bid Price Details

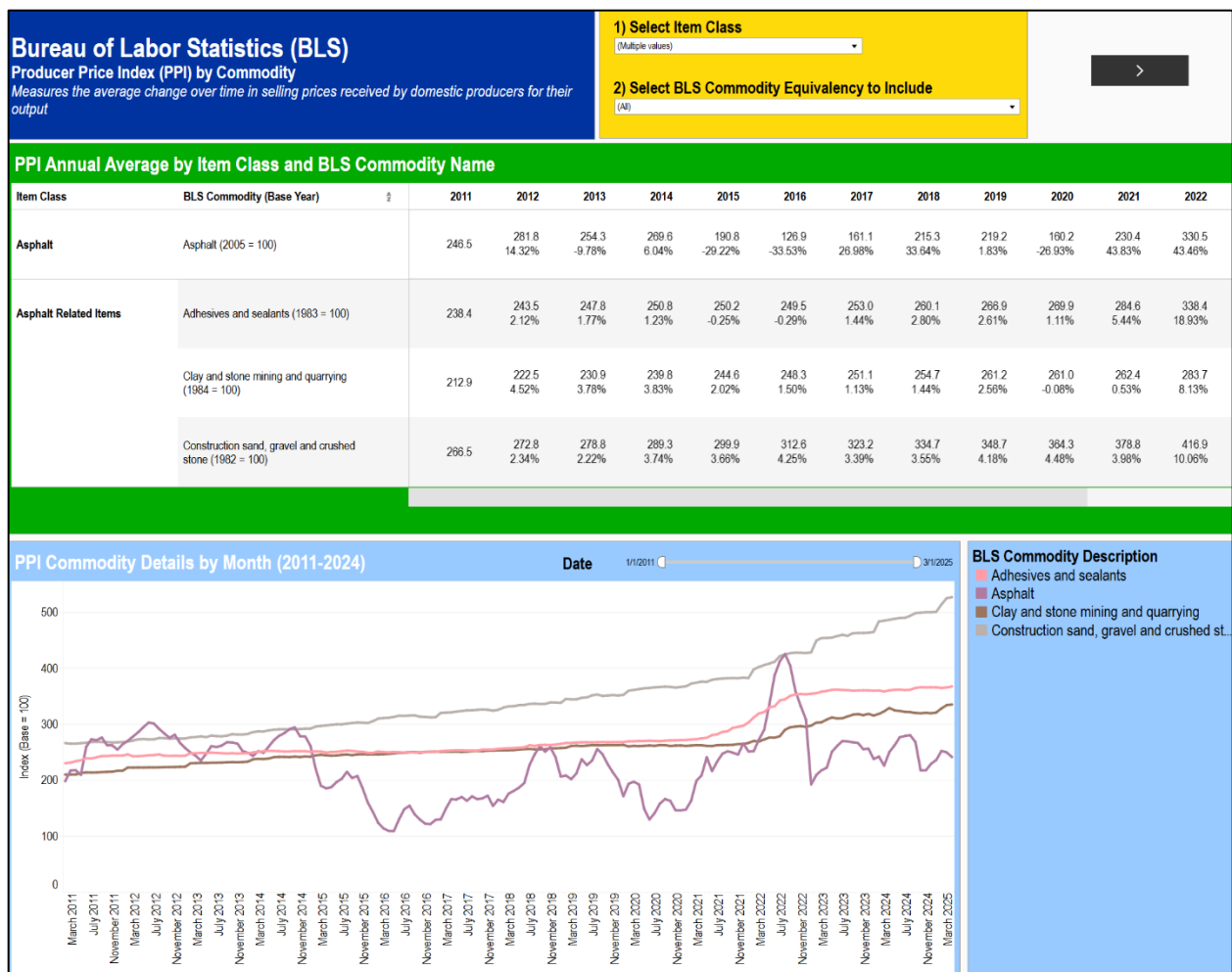
The *National Commodity Trends Dashboard* includes data from the Bureau of Labor Statistics (BLS) Producer Price Index (PPI) by Commodity and the NHCCI¹³, separated into two different sections. The BLS PPI by Commodity

¹³ <https://www.fhwa.dot.gov/policy/otps/nhcci/>

dashboard measures the average change over time in selling prices received by domestic producers for their outputs (Figure 3.7). The dashboard matches PPI Annual Average by Item Class and BLS Commodity Name. Filters are available for item class and BLS equivalent. PPI commodity details by month are also displayed. Items and commodities that could be matched between databases are shown in Table 3.1.

Table 3.1 BLS PPI Dashboard Item Class and Commodity Name(s)

Item Class	BLS Commodity Name
Asphalt	Asphalt
Asphalt Related Items	Adhesives and sealants; clay and stone mining and quarrying; construction sand, gravel, and crushed stone
Bridge Maintenance	Fabricated structural metal; fabricated structural metal and concrete reinforcing bars; nonstructural caulking compounds and sealants; paint materials; prepared paint; ready-mix concrete; special purpose coatings including marine, industrial and construction coatings
Concrete Pavement	Cement, hydraulic; concrete ingredients and related products; dry-mixed concrete materials (prepackaged sand, gravel, mortar, and cement)
Curbs and Roadside	Planting, seeding, and fertilizing machinery and attachments
Drainage	Concrete culvert pipe; concrete pipe; concrete storm sewer pipe; ductile iron pressure pipes and fittings; plastics drain, waste, and vent pipe; plastics pipe
Pavement Markings	Special purpose coatings including marine, industrial and construction coatings
Permanent Traffic Control	Intercommunications, alarm, and traffic control systems; vehicular and pedestrian traffic control equipment
ROW and ROW Fence	Steel and aluminum fences, gates (not wire), and railings, and window guards; steel fencing and fence gates
Utilities and Rail	Plastics water pipe; railroad equipment



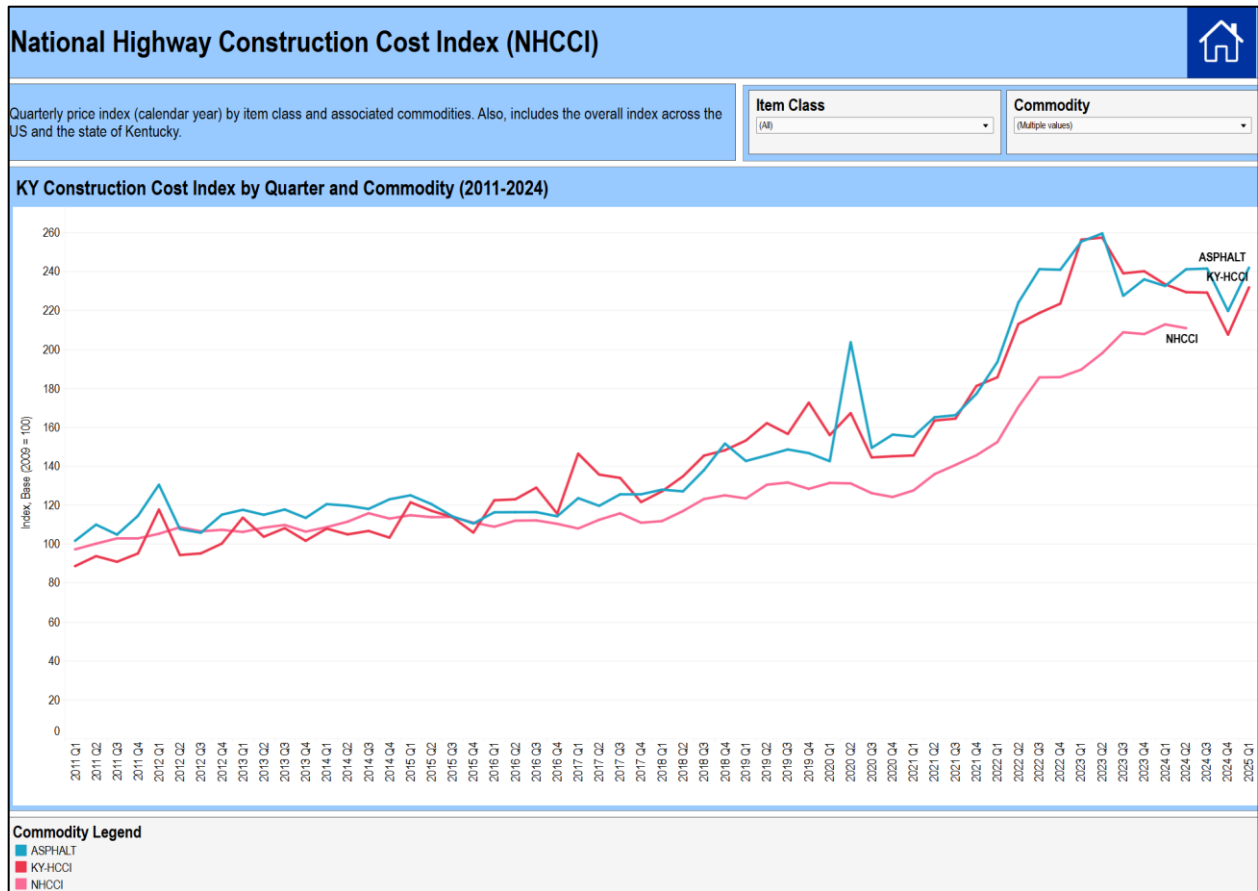


Figure 3.8 National Highway Construction Cost Index Dashboard

Section 4 Conclusion

The COVID-19 pandemic highlighted the fragility of supply chains and interconnectedness of the global economy. We quickly learned that materials which are key inputs into highway and bridge construction may not be endlessly available, that acute shortages are possible. Although the disruptions wrought by COVID-19 have largely subsided, continued uncertainty in the global economy makes it more important than ever to have tools that policymakers and KYTC agency staff can use to identify historical trends in material prices, forecast future trends, and develop strategies to respond proactively should future disruptions emerge.

The key deliverables of this project include two dashboards — a *Unit Bid Dashboard* and a *National Commodity Trends Dashboard* — that equip KYTC with the knowledge it needs to understand historical and future variability in material prices. The dashboards integrate data from several sources, including Kentucky-specific unit bid data (price and quantity), national price data, and construction cost data from across the US. Previously, the Cabinet had no means to filter and visualize these data. Because KYTC manages a large portfolio of contracts and projects, being able to spot market trends can inform decision making that balances the needs of stakeholders throughout the transportation system with the realities of price increases and material constraints. By using historical data and forecasts, KYTC can more effectively manage and deliver the Highway Plan and coordinate with its industry partners. To maximize the long-term value of these dashboards, the dashboards should be updated regularly.

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