The Electric Vehicle Transition

An Economic View

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TRENDS

Everything is Changing…

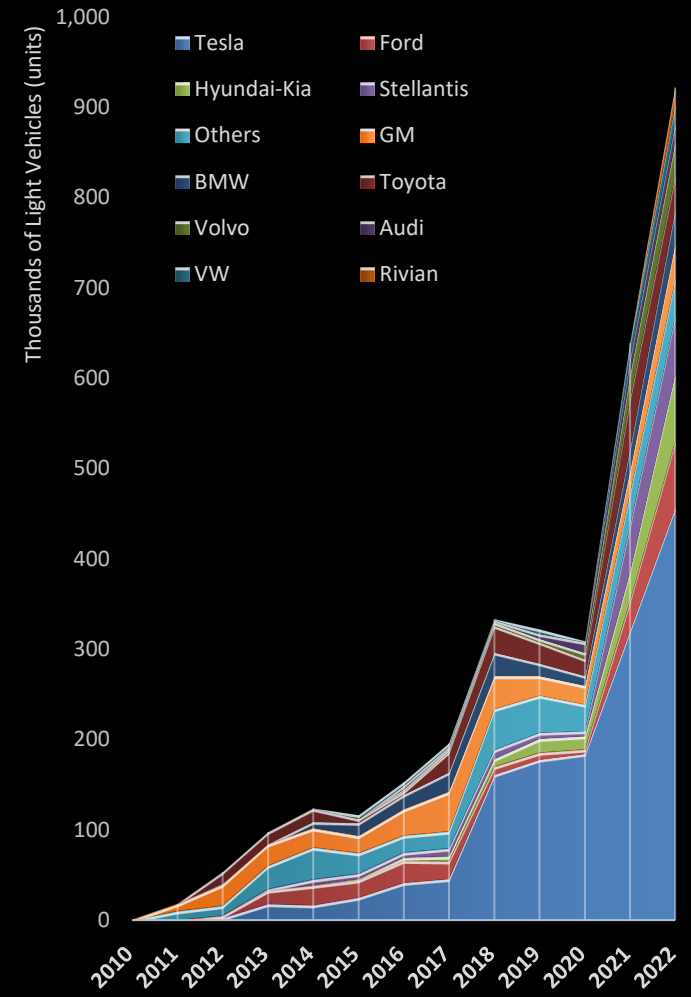
TRENDS

2021: The “Hockey Stick Moment” for Electric Vehicles

Battery Electric, Plug-in Hybrid, & Fuel Cell, Share of U.S. Sales

Source: Wards Informa

Plug-in Vehicle Volumes by Company



Source: Wards Informa; image: Tesla.com

TRENDS

Source: Federal Reserve Bank of Chicago analysis of S&P Global Mobility global light vehicle production forecast, December 2022

TRENDS

2022:
Announced U.S. EV & Battery Investment tops $73.6 Billion

Source: Atlas Public Policy via npr.org

TRENDS

Optimism Meets Reality

KPMG's 2022 survey: North American auto executives project 35% EV market share by 2030 vs. 52% share in the same survey in 2021

Source: KPMG 23rd Annual Global Automotive Executive Survey

TRENDS

New purchase, lease, & manufacturing incentives in the Inflation Reduction Act

TRENDS

Despite lower production, the industry has been very profitable

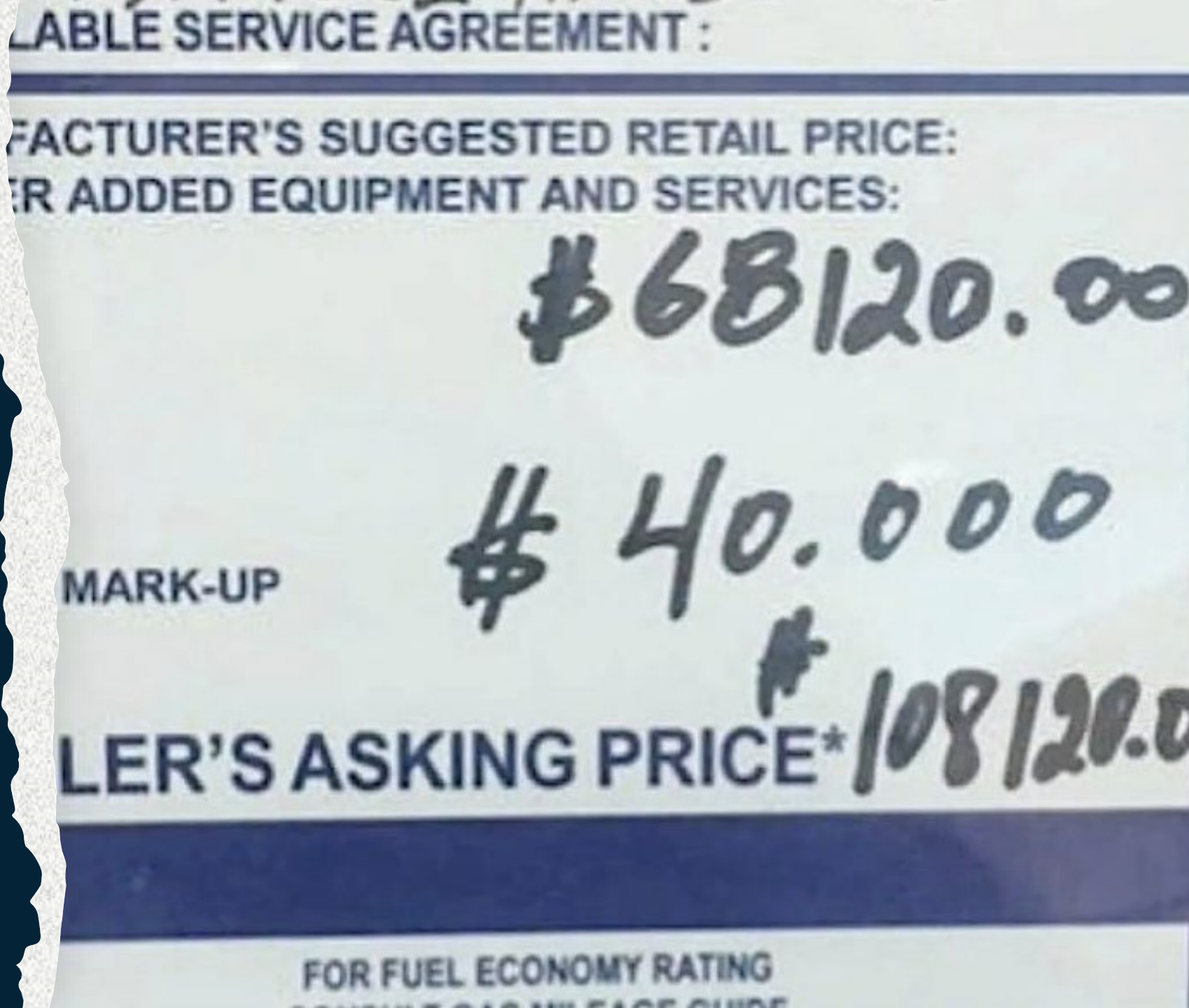
Source: U.S. Bureau of Economic Analysis, Corporate profits with inventory valuation adjustments: Domestic industries: Nonfinancial: Manufacturing: Durable goods: Motor vehicles, bodies and trailers, and parts [N411RC1Q027SBEA], & Board of Governors of the Federal Reserve System (US), Industrial Production: Manufacturing: Durable Goods: Motor Vehicles and Parts (NAICS = 3361-3) [IPG3361T3SQ]. Both retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/N411RC1Q027SBEA, January 6, 2023

TRENDS

There are many hurdles ahead

CRITICAL ISSUES

Prices are rising; & EV prices are 35% higher



CRITICAL ISSUES

Jobs & job quality are changing

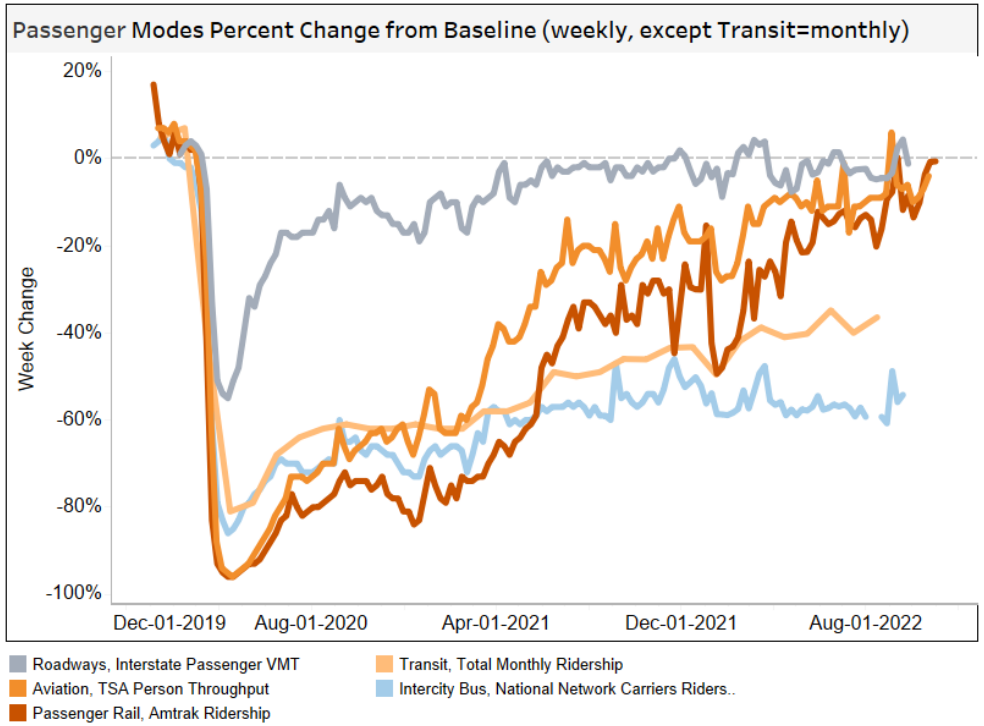
Economic Factors

Sales, production, inventory, supply chains, & capac

ECONOMIC FACTORS

Safe, reliable, & affordable transportation matters

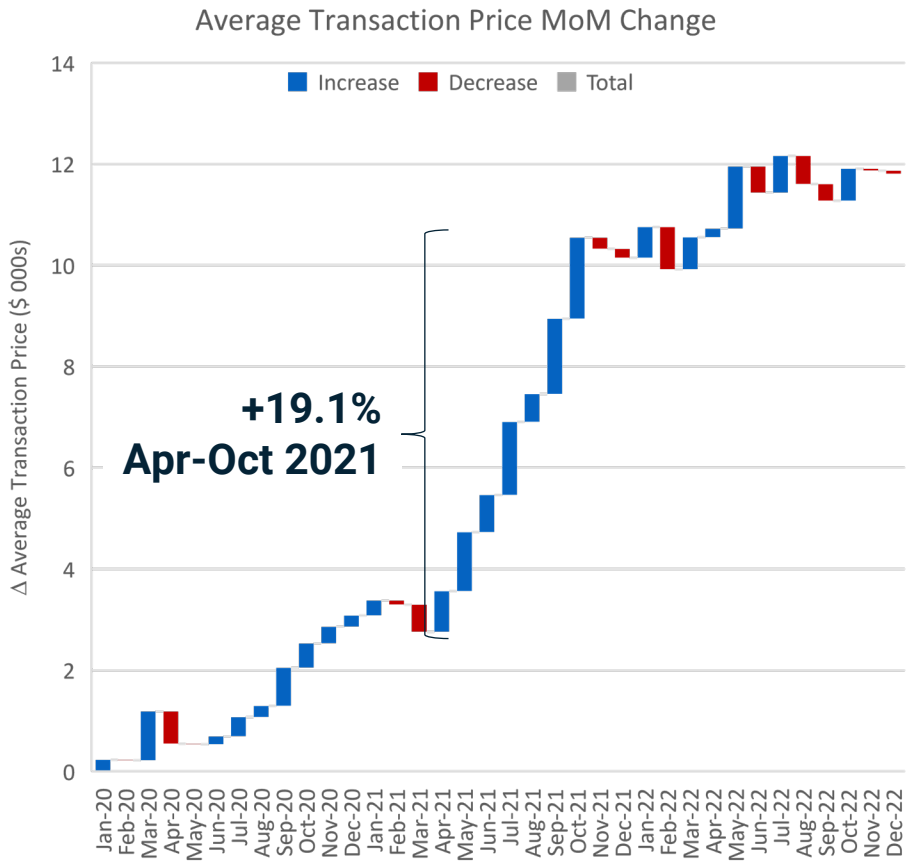
- 68% of adults commute to work alone in a car
- Transit & bus passenger miles have not recovered to pre-pandemic levels
- Some employers have started providing transportation to work
- Commute miles are 35% of personal travel
- Improved transportation options could impact labor force participation

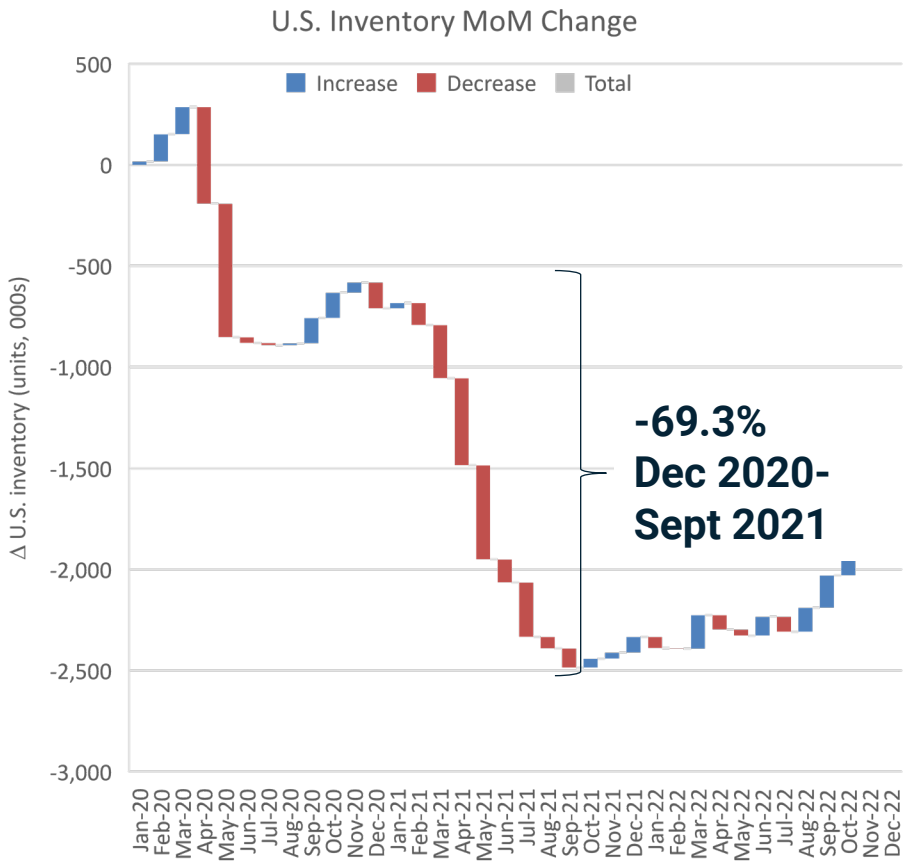


Source: U.S. Department of Transportation; Bureau of Transportation Statistics

ECONOMIC FACTORS

Light vehicle prices plateauing while inventory begins to tick upward





Sources: Kelley Blue Book (ATPs) & Ward's Informa (Inventory)

ECONOMIC FACTORS

Raw material prices remain elevated

- Highly volatile raw materials prices impacted by a wide variety of factors
- Even with prices coming down in recent months, the overall bill of materials remains higher than 2012-2020 period

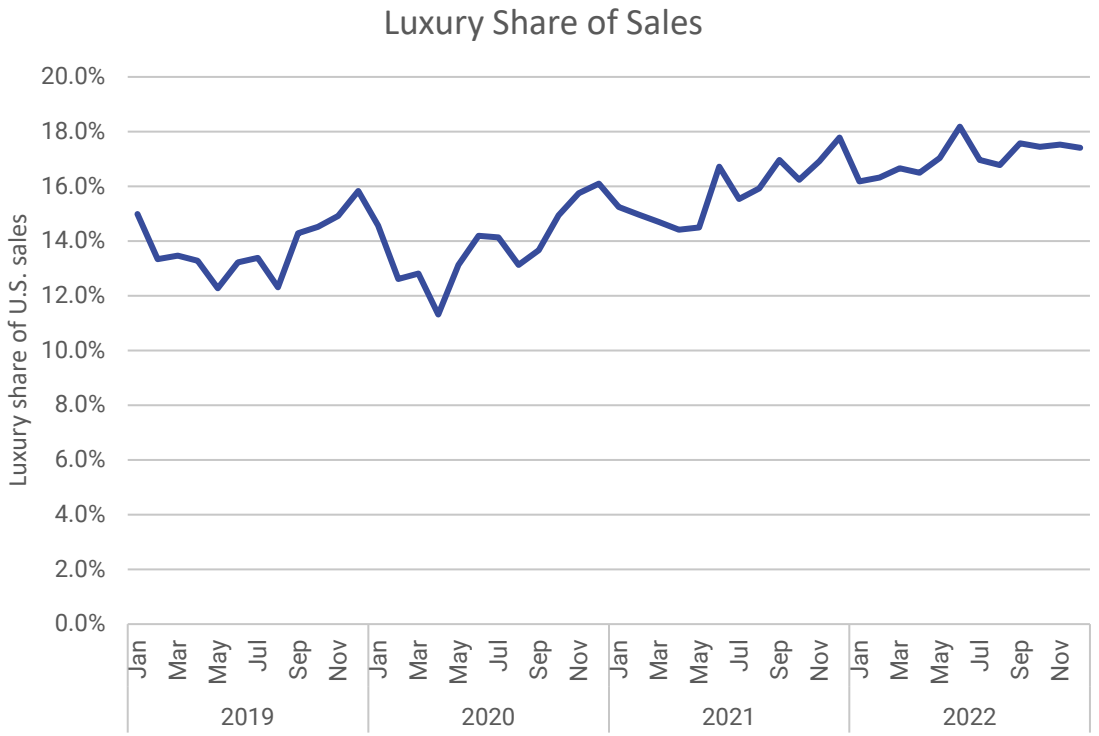
Exhibit 15: BofA Global Research estimated total raw material $ cost per average vehicle
We estimate that the total raw material $ cost per average vehicle has decreased in recent months, although it has been volatile over time

Source: Bank of America Global Research Estimates

ECONOMIC FACTORS

Luxury share remains elevated

- Luxury share has inched up—averaging 17% in 2022
- Consequences for future used vehicles?
  - Rich mix
  - Very little leasing
  - Underproduction in 2008-2009 & 2021-2022

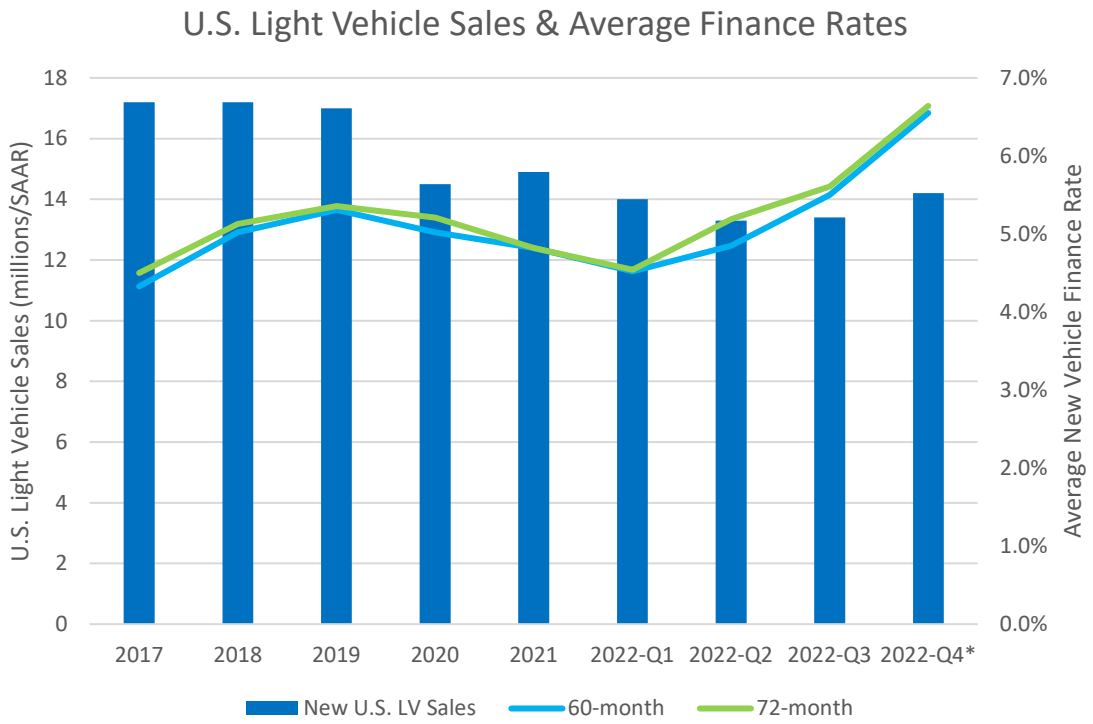


Source: Cox Automotive

ECONOMIC FACTORS

New light vehicle finance rates & sales trends

- Sales were higher (14.2M SAAR) in Q4 than Q1 (14M SAAR) even with +107 bps increase in 72-month finance rates
- Due to the extended period of supply-constrained conditions, it may be difficult to determine the full impact of higher rates on new light vehicle sales



Source: Federal Reserve Statistical Release (Q4 number is November 2022), Ward's Intelligence, November 2022

ECONOMIC FACTORS

Summary of Economic Projections

- "We think we'll have to maintain a restrictive stance for some time."
- "There are no rate cuts in 2023 in the SEP."

– Fed Chair Jay Powell

Figure 5. Uncertainty and risks in projections of the federal funds rate

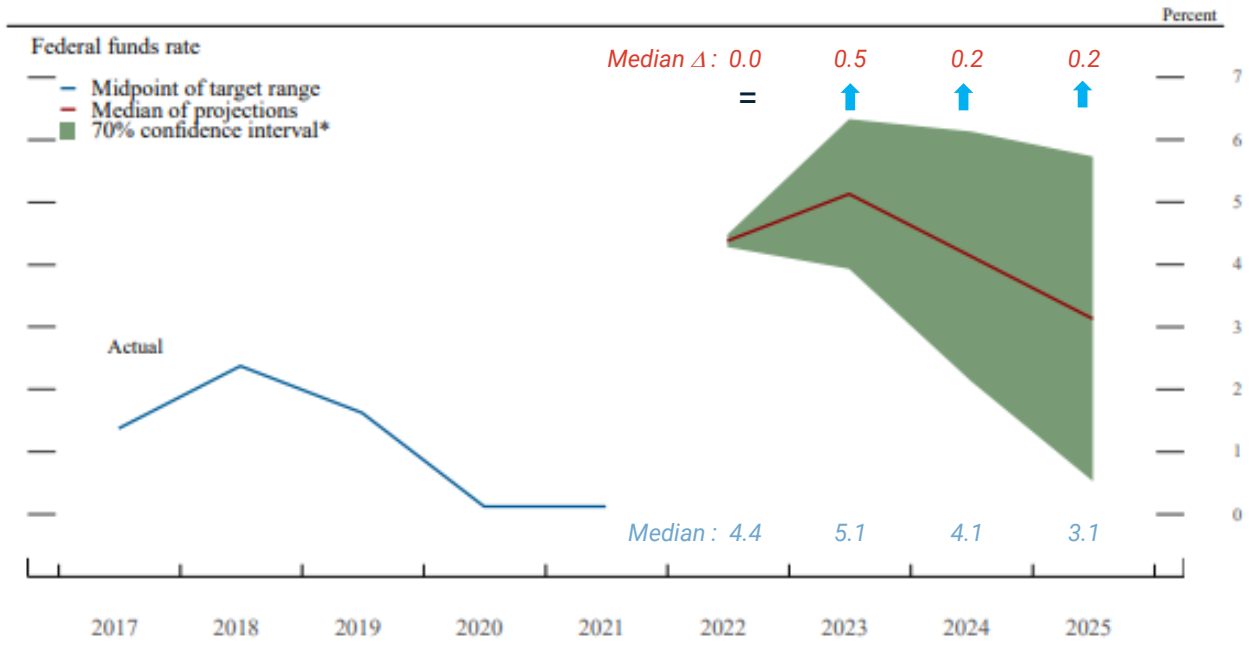
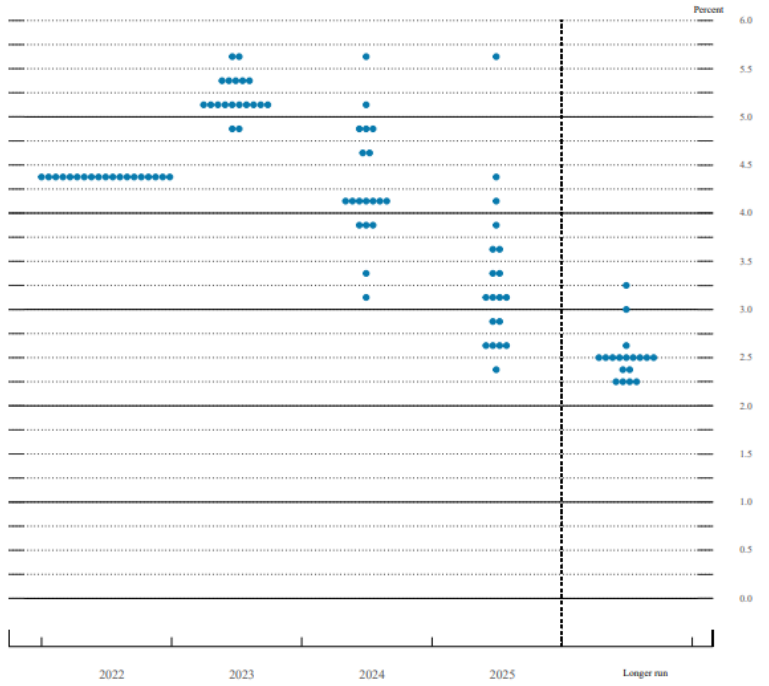


Figure 2. FOMC participants' assessments of appropriate monetary policy: Midpoint of target range or target level for the federal funds rate



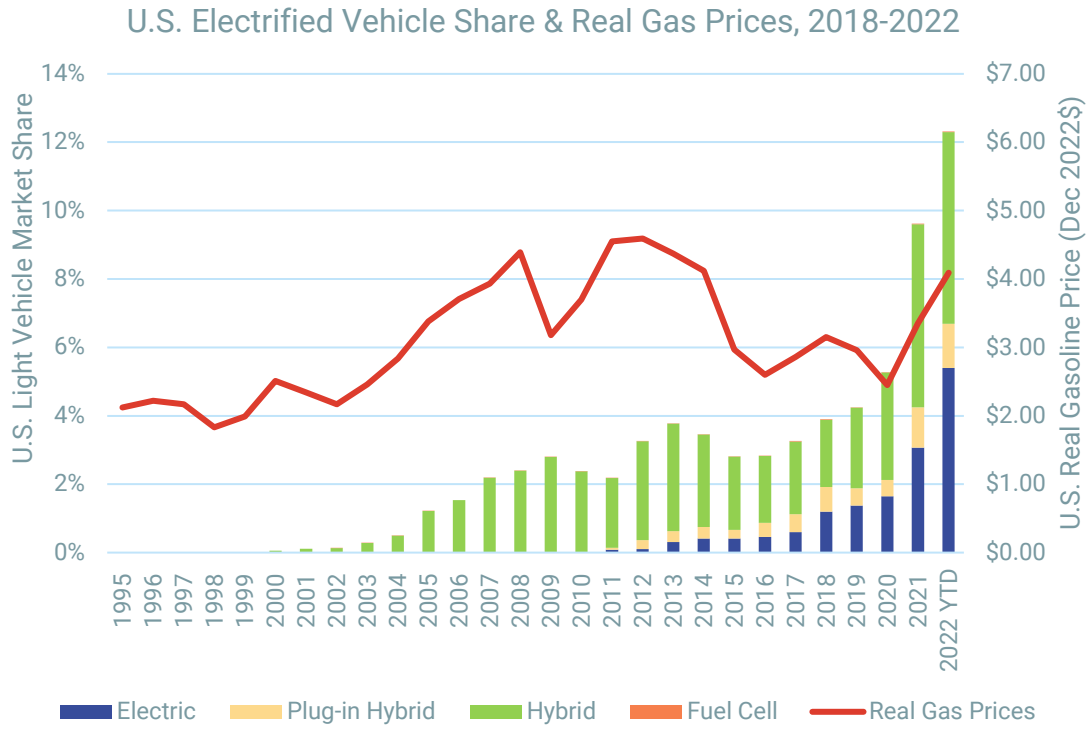
Source: Federal Reserve Board of Governors

Change since September 2022 SEP: Higher ⬆ Same =

ECONOMIC FACTORS

EV & electrified vehicles are gaining U.S. market share

- Several models are only available as BEV or HEV now—such as the Toyota Sienna minivan or the GMC Hummer
- Total electrified share has more than doubled in pandemic from 5.2% in 2020 to 12.3% in 2022

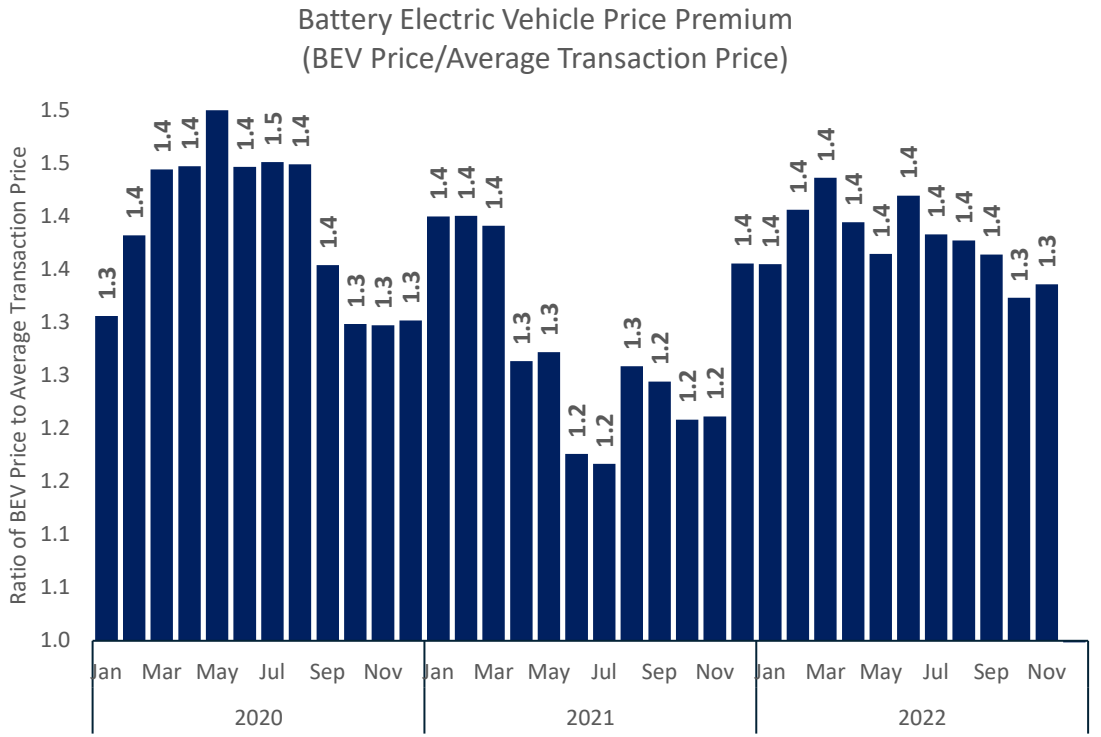


Source: Ward's Intelligence & U.S. Department of Energy, Energy Information Agency, Updated 1/6/2023

ECONOMIC FACTORS

BEV prices are influenced by model availability & mix

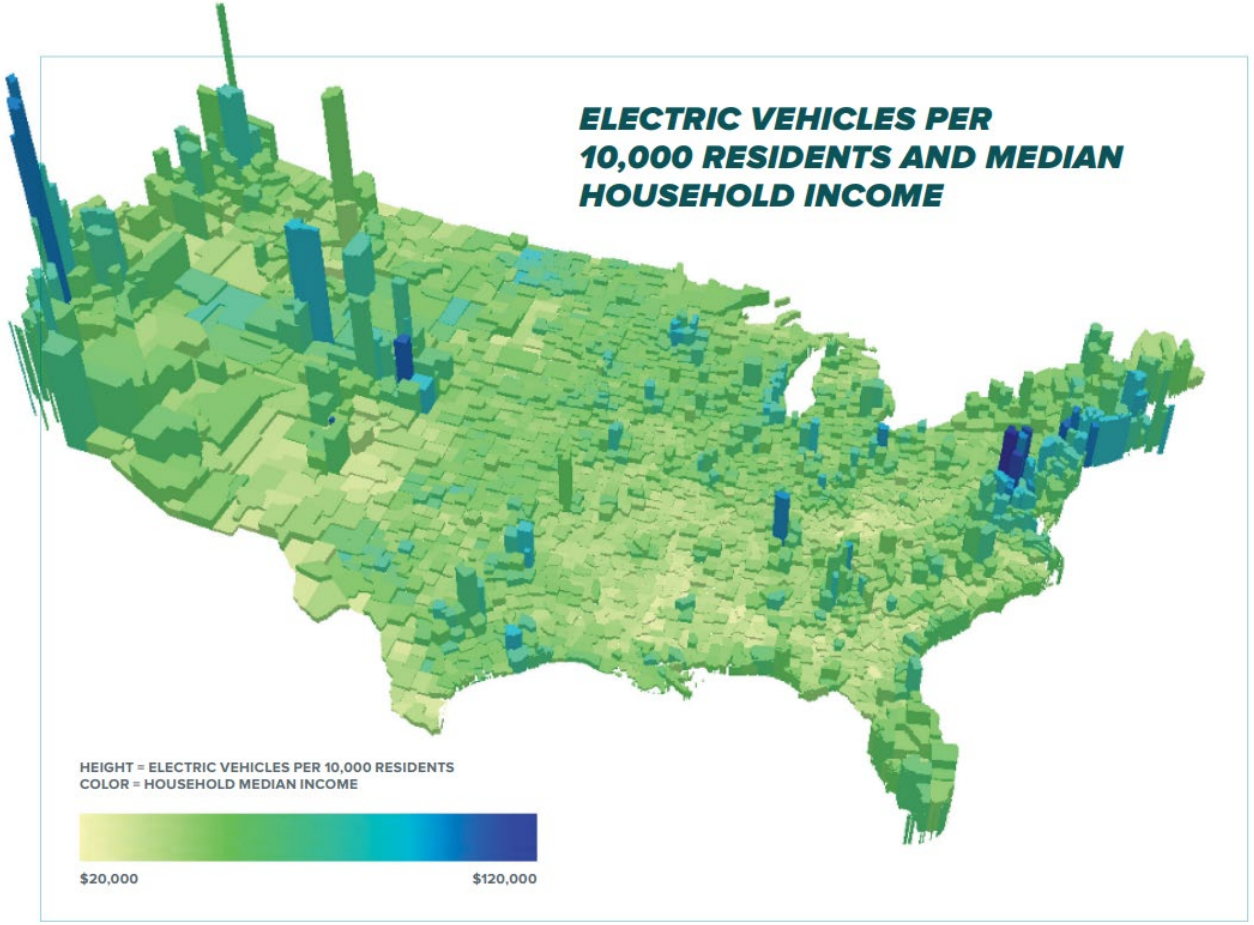
- Factors that mitigate higher BEV prices:
  - Production/supply chain recovery
  - Moderating raw materials prices
  - Cooler demand/normalized mix
  - New model introductions & greater availability of moderately-priced EVs
  - Production efficiencies
  - Technology improvements
  - IRA MSRP caps



Source: Kelley Blue Book Monthly Average Transaction Price Reports

ECONOMIC FACTORS

EV ownership is concentrated on the coasts & mountain states—and among high income households

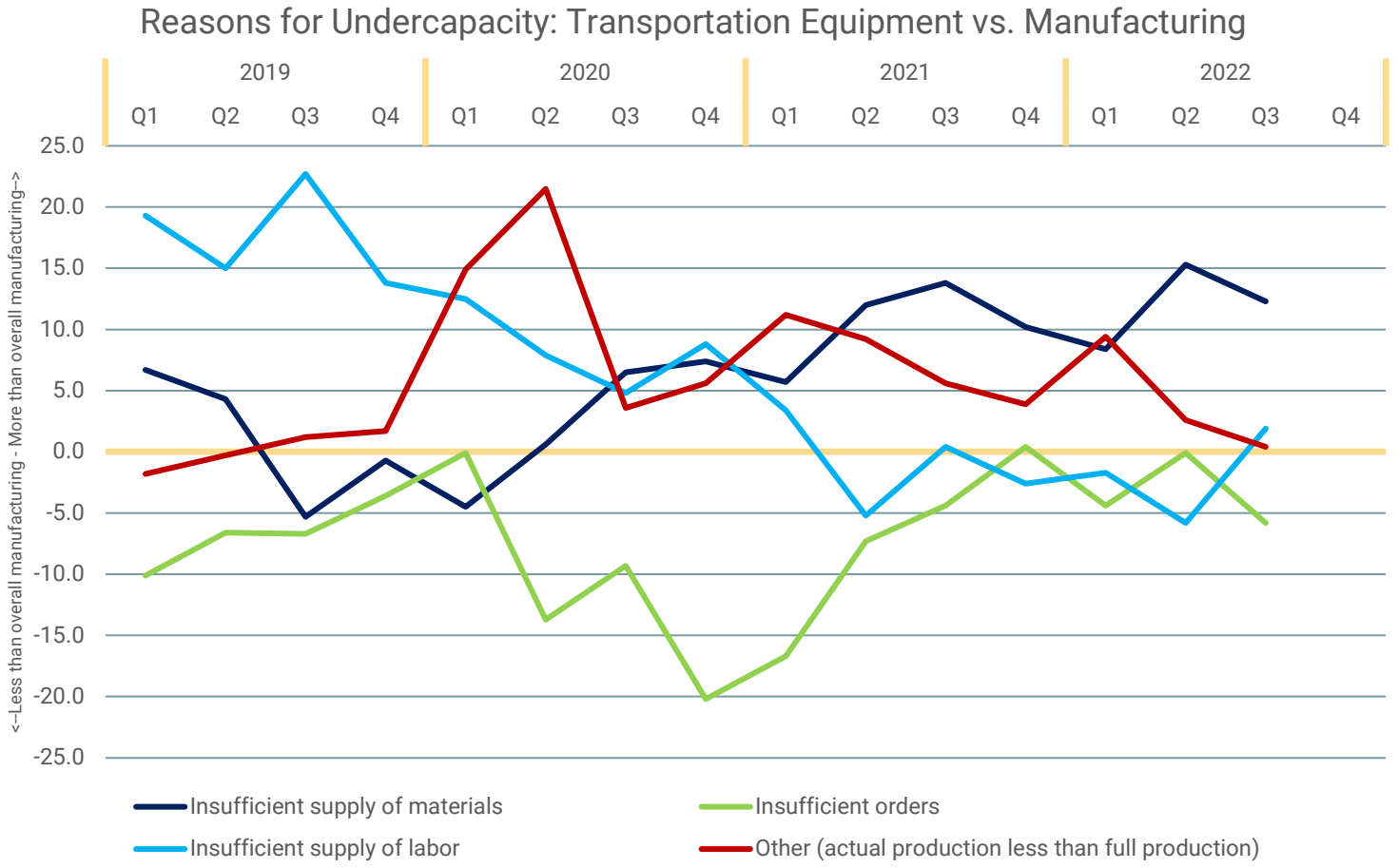


Sources: Alliance for Automotive Innovation Annual Report

ECONOMIC FACTORS

Undercapacity Reasons

- Relative to manufacturing, the transportation equipment sector has seen:
  - Increased underutilization due to insufficient materials & labor constraints, but…
  - Orders & other factors are less of a concern in transportation equipment

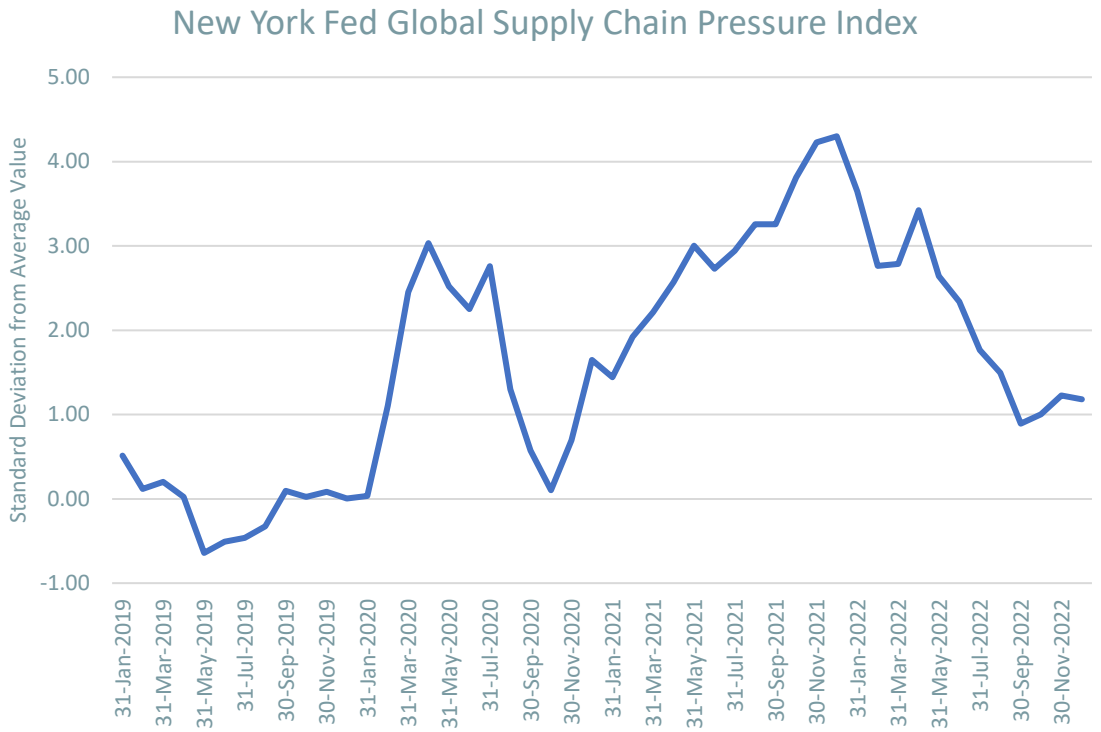


Source: U.S. Census, Quarterly Survey of Plant Capacity Utilization

ECONOMIC FACTORS

Supply chain pressure may be releasing

- The net change in supply chain flows has been positive
- Still not back to normal (0)
- There is always a potential for more bottlenecks to surface

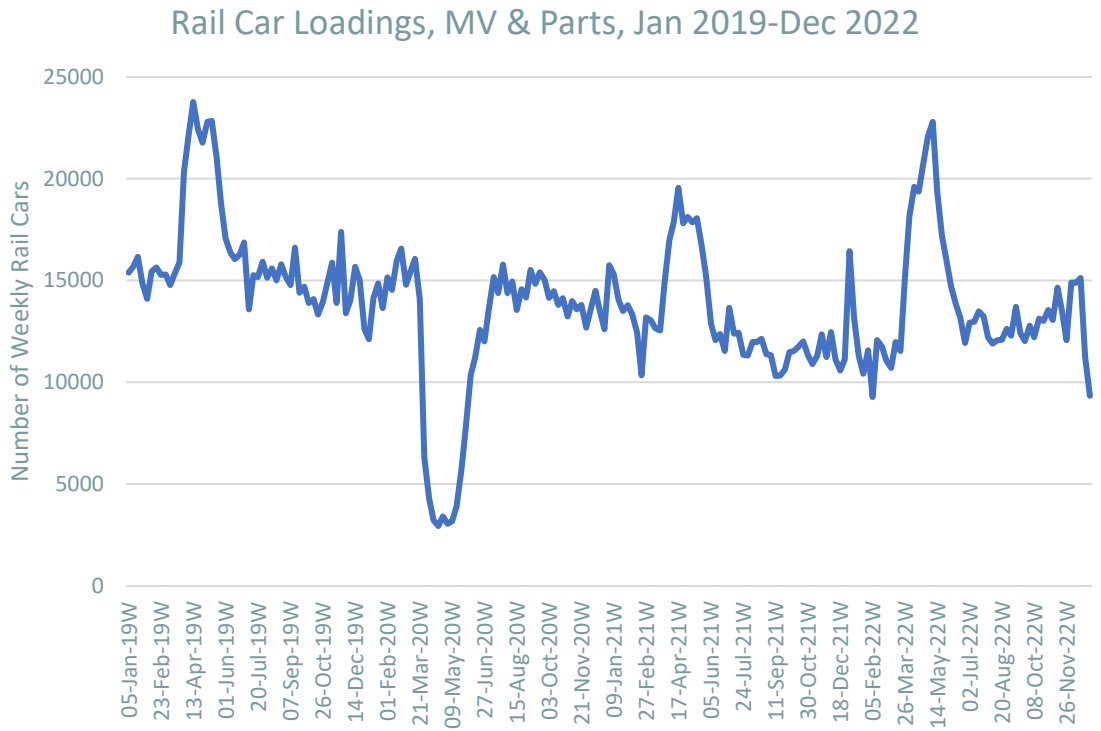


Source: Federal Reserve Bank of New York

ECONOMIC FACTORS

Shipping & logistics remain challenged

- Recent rail car loadings are trending slightly upward (rail strike averted, but labor relations are strained)
- Port labor talks are stalled (expected to go into 2023)
- Shipping container costs are down, but still above pre-pandemic levels
- Truck driver shortage remains

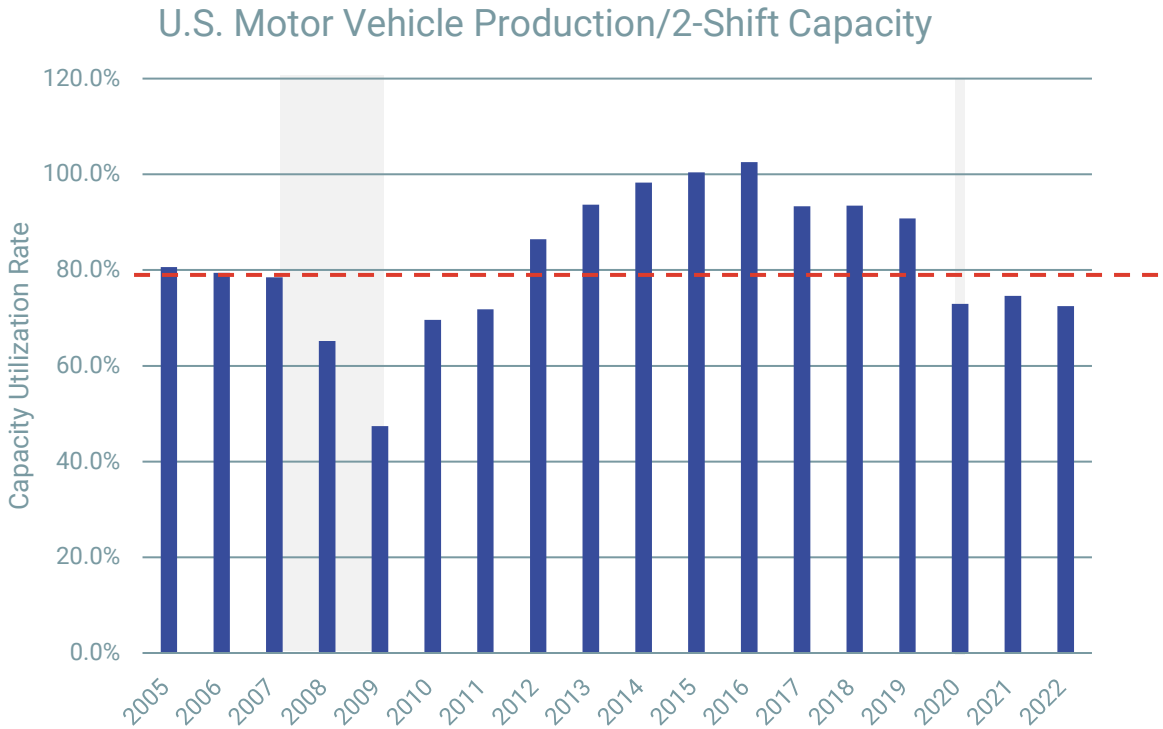


Source: Association of American Railroads, Haver Analytics

ECONOMIC FACTORS

Production capacity utilization is very low

- U.S. 2-shift/straight-time net capacity -500K units since 2008
  - Closed plants = 3 million units of capacity
  - New plants = 1.8 million units of capacity
- Concern re: fate of potential underutilized assembly, powertrain, & component plants
- Productivity will suffer as internal combustion engine (ICE) vehicle & component production ramps down & electric vehicle (EV) & component production ramps up



Source: Author's calculations based on Ward's data through Q3 2022

U.S. Industrial Policy

Potentially game-changing incentives for EVs

INDUSTRIAL POLICY

The Inflation Reduction Act is aimed at improving EV affordability: New incentives for new & used vehicles

2022

- $7,500 if…
  - North American assembled
  - Not GM or Tesla
  - Adds FCEV to the program

Starting 1 January 2023

- $3,750/$3,750 if…
  - Battery components & critical minerals content requirements met
  - MSRP < $55K cars/ $80K trucks/vans/SUVs
  - AGI cap $300K/225K/150K
  - 7 kWh minimum
- $4,000 or 30% of sales price for used EVs <$25K & 2+ years old with AGI $150K/112.5K/75K

Starting 1 January 2024

- No "entity of concern" battery components (China, Russia, Iran, North Korea)

Starting 1 January 2025

- No "entity of concern" battery components or critical minerals

New *Commercial* Clean Vehicle Tax Credits

- Up to $7,500 for GVW <14K pounds and $40K for GVW >14K pounds
- It appears there are no North American assembly, critical minerals or battery component content requirements
- Leases qualify

INDUSTRIAL POLICY

The Inflation Reduction Act aims to lower producer costs, too

Manufacturing Tax Credits

- $35/kWh for battery cells produced
- $10/kWh for battery modules
- 10% of cost incurred for critical minerals

Domestic Manufacturing Conversion Grants

- Grants for re-equipping, expanding, or establishing a U.S. manufacturing facility to produce BEV, PHEV, PEV, or FCEVs

Advanced Energy Project Credit

- For establishing, expanding, or re-equipping facilities for producing a wide array of clean energy products including advanced light-, medium-, & heavy-duty vehicles, energy storage (batteries), & fuel cell equipment

Advanced Technology Vehicle Manufacturing

- Adds funding to program to make direct loans for the cost of establishing or expanding U.S. manufacturing facilities that produce low or zero GHG vehicles or components

Infrastructure Investment & Jobs Act

- $7.5B in formula & competitive grants to incentivize EV charging build-out
- Funding for grid upgrades & resilience
- $9.5B in clean hydrogen manufacturing programs

Source: Federal Reserve Bank of Chicago Analysis of Inflation Reduction Act, P.L. 117-169.

INDUSTRIAL POLICY

China is a major player in battery, components & minerals production

- China produces 80% of global battery cells & has invested in critical minerals mining, refining, & processing across the globe
  - Dominant investor in domestic & foreign Cobalt extraction & processing
  - Controls 61% of global lithium refining
  - Controls 100% of natural graphite processing (battery anodes)

- Global lack of sufficient mining, processing, & refining capacity for critical minerals
- Mining permits take years to approve
- Even when a mine is operating, it could take 2-3 years to produce "battery grade" materials
- Recycling will be key, but it is not sufficient in early years when few vehicle batteries are available to recycle & reclaim minerals (or be put to second use
- Inflation Reduction Act's regulatory phase will determine how the "foreign entities of concern" language will be operationalized

Source: U.S. Department of Energy, America's Strategy to Secure the Supply Chain for a Robust Clean Energy Transition

UAW & Unifor Talks

Major Issues & Considerations

UNION NEGOTIATIONS

Many challenges ahead in addition to the EV transition

ISSUES

- EVs—jobs, job quality, organizing new plants
- Job security
- Wages
- COLA
- Health care
- Temporary-to-Permanent Conversions
- Overtime pay
- Vacation & holidays
- Profit sharing
- Outsourcing/insourcing

CONSIDERATIONS

- New leadership at UAW, Unifor, & automakers
- UAW President, VP, & remaining regional director run-offs not decided until March 2023
- Profitable operations for more than a decade
- High inflation environment
- Economic uncertainty

UAW contracts expire:	14 September 2023
Unifor contracts expire:	18 September 2023

Outlook

Overview of outside forecasts

OUTLOOK

2023 U.S. sales forecasts trend upward

- 2019: 17.1 million
- 2020: 14.6 million
- 2021: 15.1 million
- 2022: 13.7-13.9 million
- The 2023 consensus is just above 2020 sales level, but still way short of 2019 U.S. sales
- Top 10 Average forecasts are more bullish—with 2023 back to 16-million-units

	2022	2023
Blue Chip Consensus	13.9	14.8
Blue Chip Top 10 Average	14.1	16.0
Bank of America	13.8	14.3
Economist Intelligence Unit	14.0	14.5
S&P Global	13.7	14.7
Comerica	13.9	14.8
LSA Research Seminar in Quantitative Economics University of Michigan	15.1	15.5
Wells Fargo	13.9	15.9
Moody's	14.0	16.1
Morgan Stanley	15.5	16.5
JPMorganChase	13.9	16.7

Source: Wolters Kluwer/Haver Analytics; UM RSQE

www.chicagofed.org