

Industry Trend

China Battery Dominance: Playing Catch-Up

Context / Description:

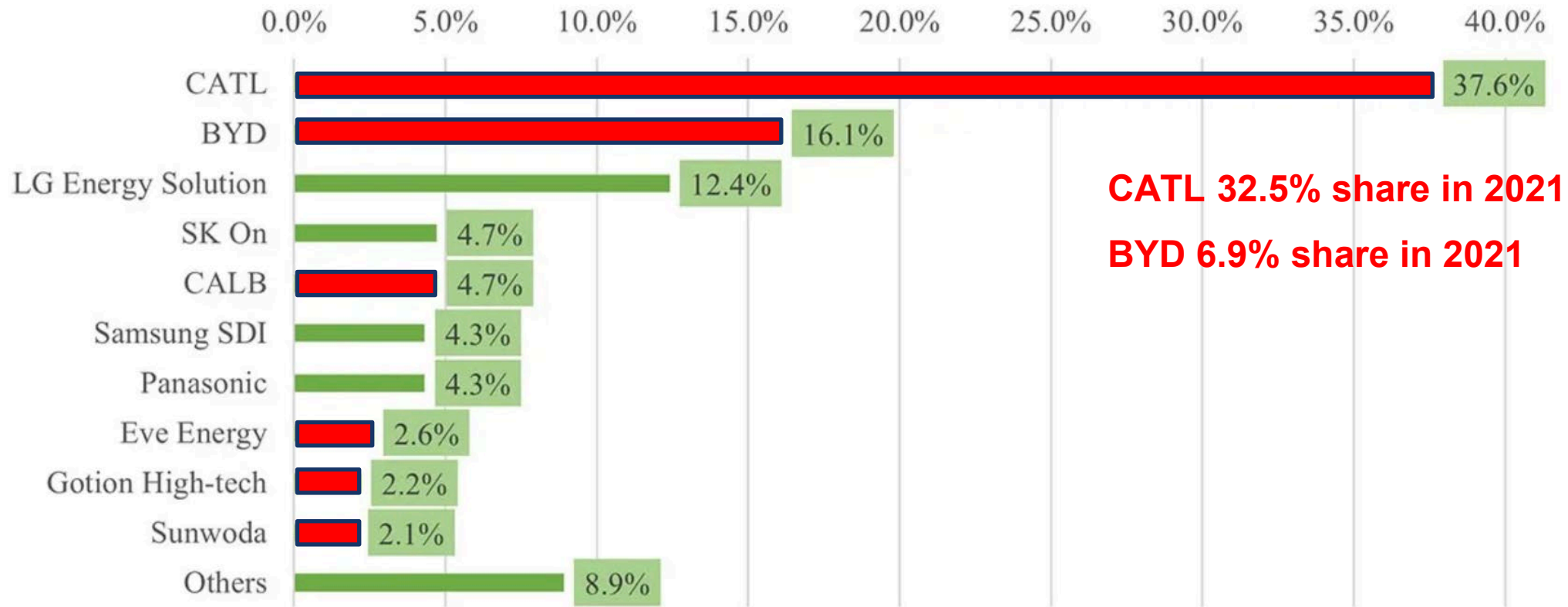
- After an estimated \$30B in government support over two decades, China emerges as the undisputed leader in lithium ion battery technology
- China exerts influence / control over critical battery minerals: cobalt, nickel, graphite and lithium
- Battery accounts for approx. 40% of EV cost.
Critical question for Rest of World: How to compete?

Headlines:

- We Rely Heavily on Lithium Ion Batteries – But There’s a Growing Array of Alternatives (BBC, March 20, 2024)
- Even Combined, Korea’s Top 3 Battery Makers Fall Behind China’s CATL in Q1 Shipments (Business Korea, July 10, 2024)
- Struggling Northvolt Stokes Fear for Europe’s Battery Future (Reuters, Sept. 13, 2024)



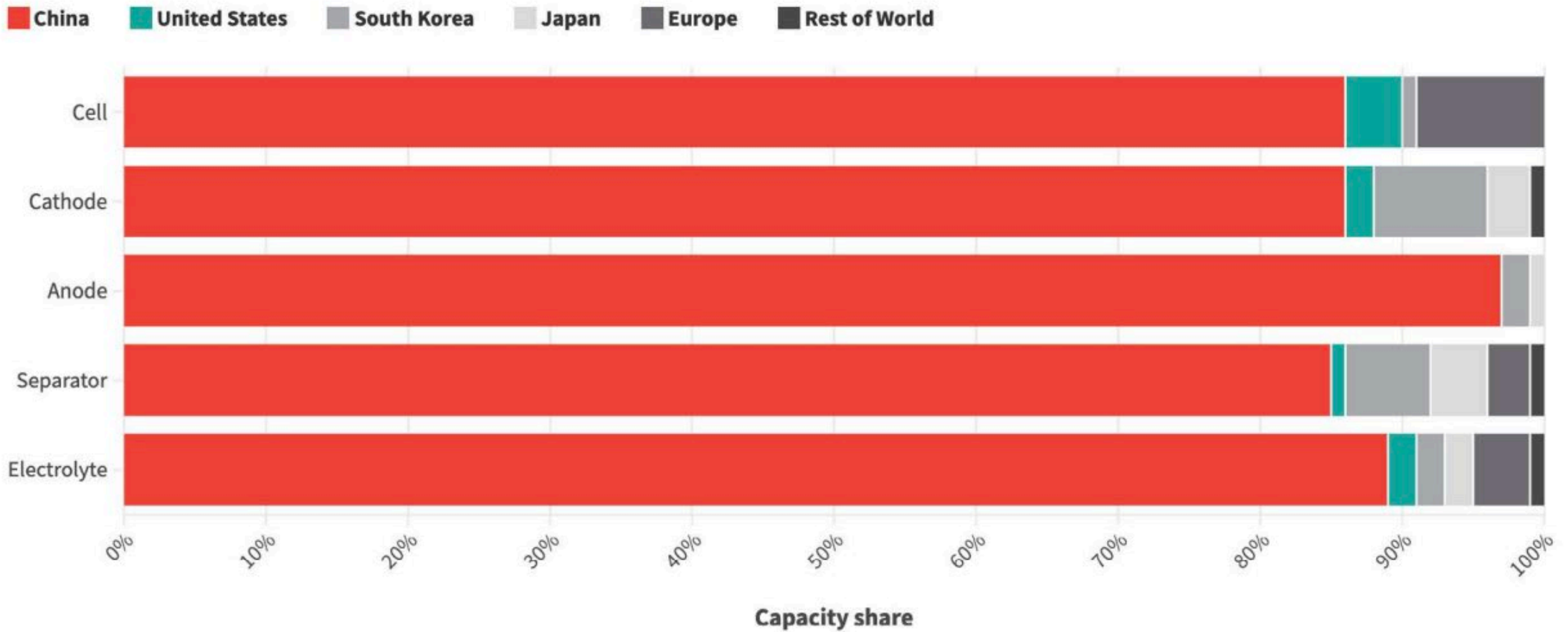
Market share of world's top EV battery makers (Jan-Jul 2024)



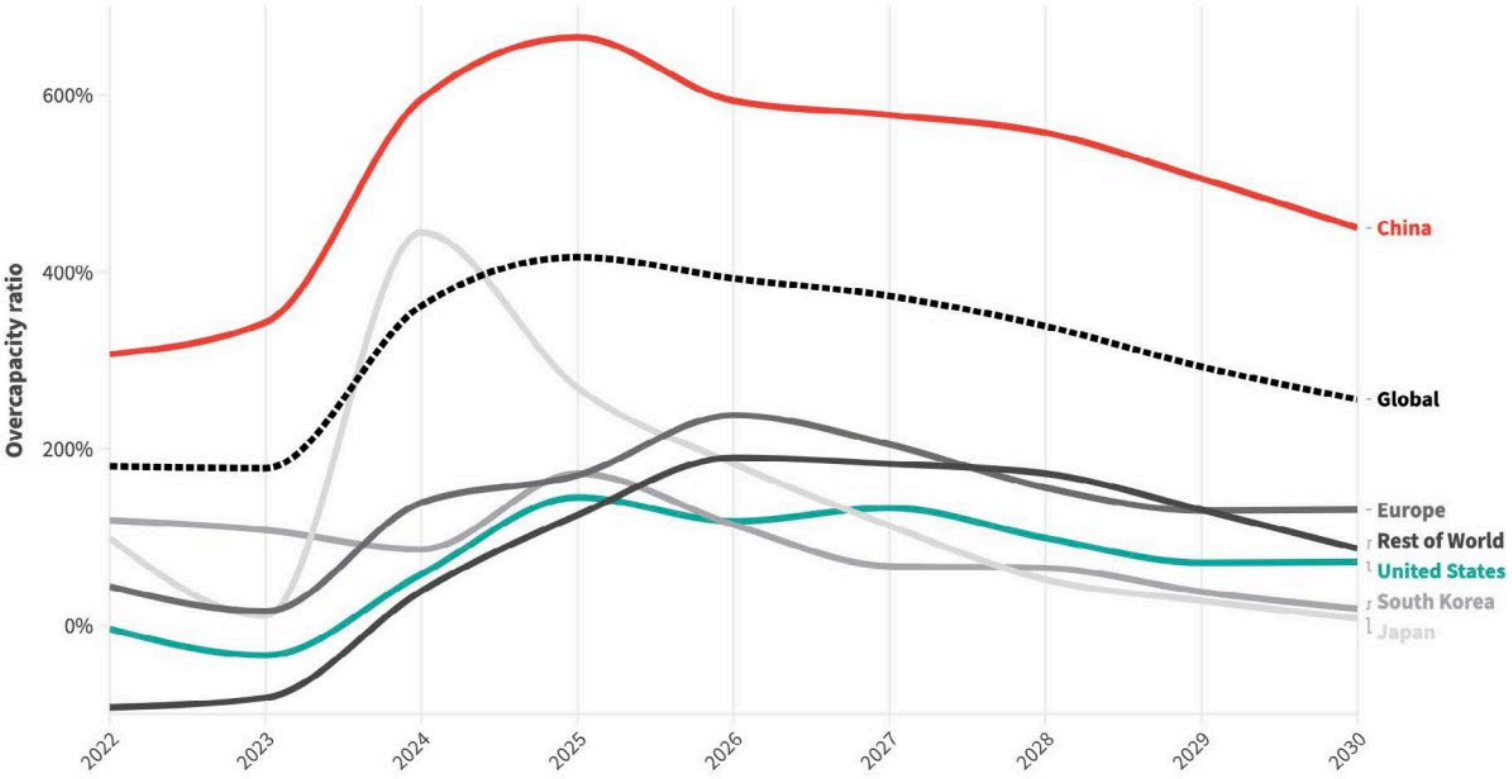
CATL 32.5% share in 2021

BYD 6.9% share in 2021

Share of Global Battery Market by Country



Overcapacity in EV Battery Production by Country: 2022 to 2030F



Source: BloombergNEF Long-Term EV Outlook 2024

Geopolitical Trend

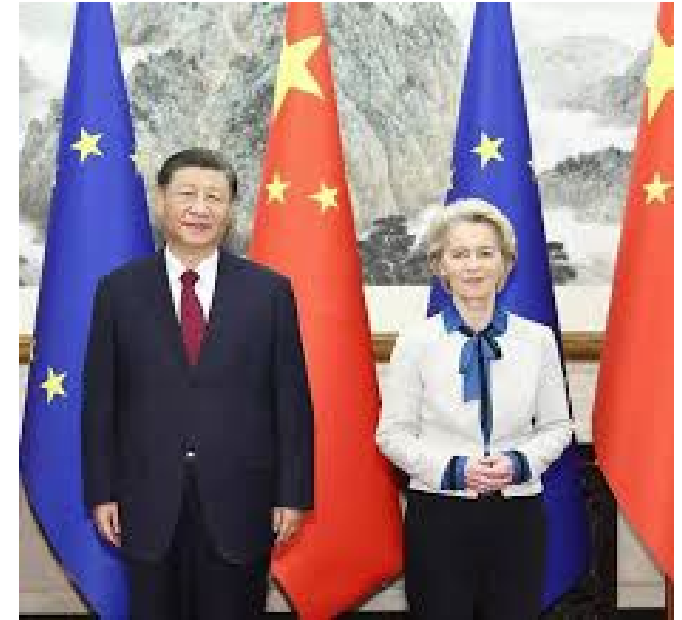
Global Trade Wars Intensify

Context / Description:

- After decades of globalization, the world bifurcates
- Massive impact on global mobility industries: automotive, rail, shipbuilding ... aviation?
- "National security" considerations profoundly shape global industries

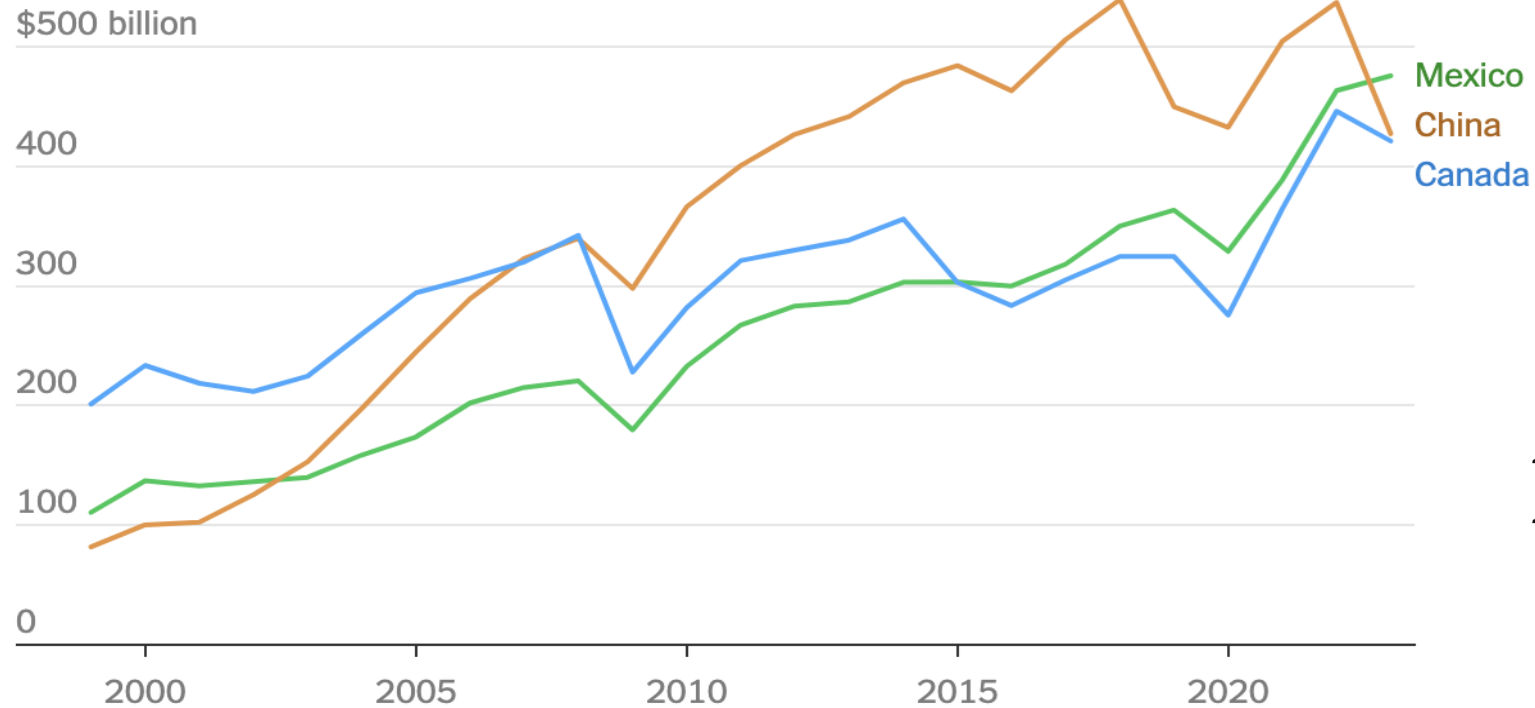
Headlines:

- Shipbuilding: The New Battleground in the US-China Trade War (Financial Times, March 12, 2024)
- Biden to Quadruple Tariffs on Chinese EVs (May 10, 2024)
- Can China Smash the Airbus-Boeing Duopoly? (The Economist, July 25, 2024)
- Europe to Hit China with EV Tariffs That Its Own Automakers Oppose (Wall Street Journal, June 12, 2024)
- EU and China May Be Heading Toward a Trade War (The Diplomat, October 1, 2024)



Imports from China fell last year

U.S. imports of goods by origin



Sources: U.S. Census Bureau; U.S. Bureau of Economic Analysis • By The New York Times

Feb. 7, 2024

The New York Times

For First Time in Two Decades, U.S. Buys More From Mexico Than China

Car Bloat: Larger, Heavier and More Dangerous Vehicles



1975 Ford F-150

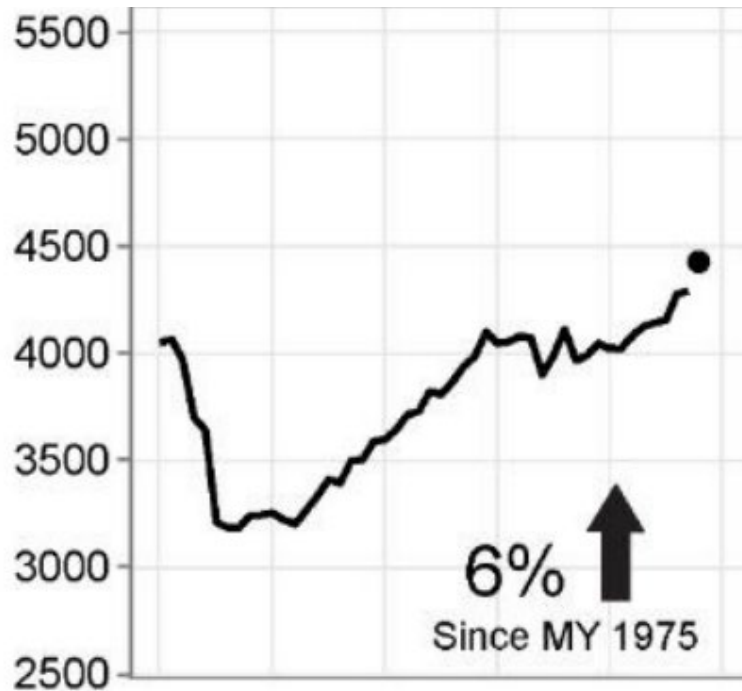


2000 Ford F-150



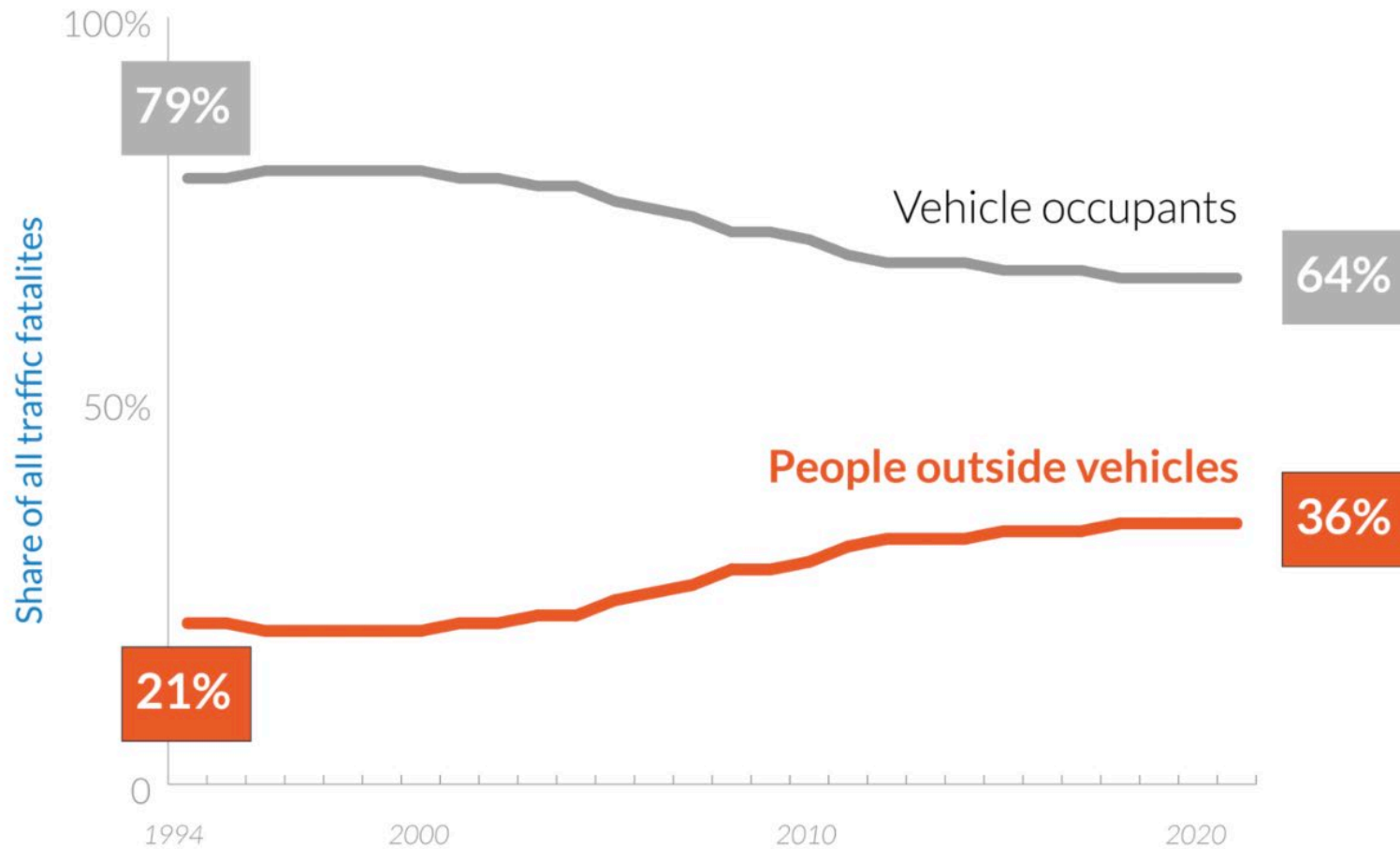
2020 Ford F-150

US Light Vehicle Average Weight (lbs) 1975 - 2023



- The average passenger vehicle in the U.S. is 4 inches wider, 10 inches longer, 8 inches taller, and 1000 pounds heavier than its counterparts of 30 years ago
- **U.S. pedestrian crash deaths have risen roughly 89% since 2010: over 7500 pedestrians died after being struck by a vehicle in 2022** (GHSA and NHTSA FARS)
- **A 10 cm increase in front-end height causes a 22% increase in pedestrian fatality risk** (Justin Tyndall, Univ. of Hawaii)

A growing share of all traffic deaths are people outside of vehicles



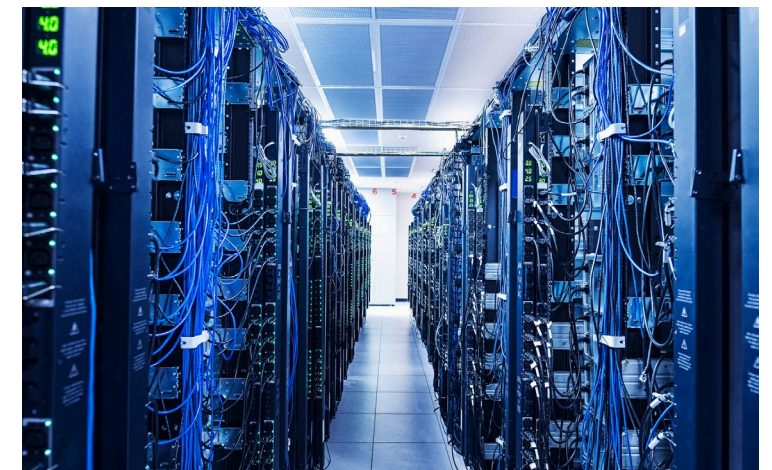
Electricity Supply: The Next Constraint on Mobility Electrification

Context / Description:

- Demand for electricity will significantly increase due to EV adoption, heat pumps, data centers and AI
- Supply of electricity is constrained – particularly by grid capacity
- Electricity prices likely to experience upward pressure

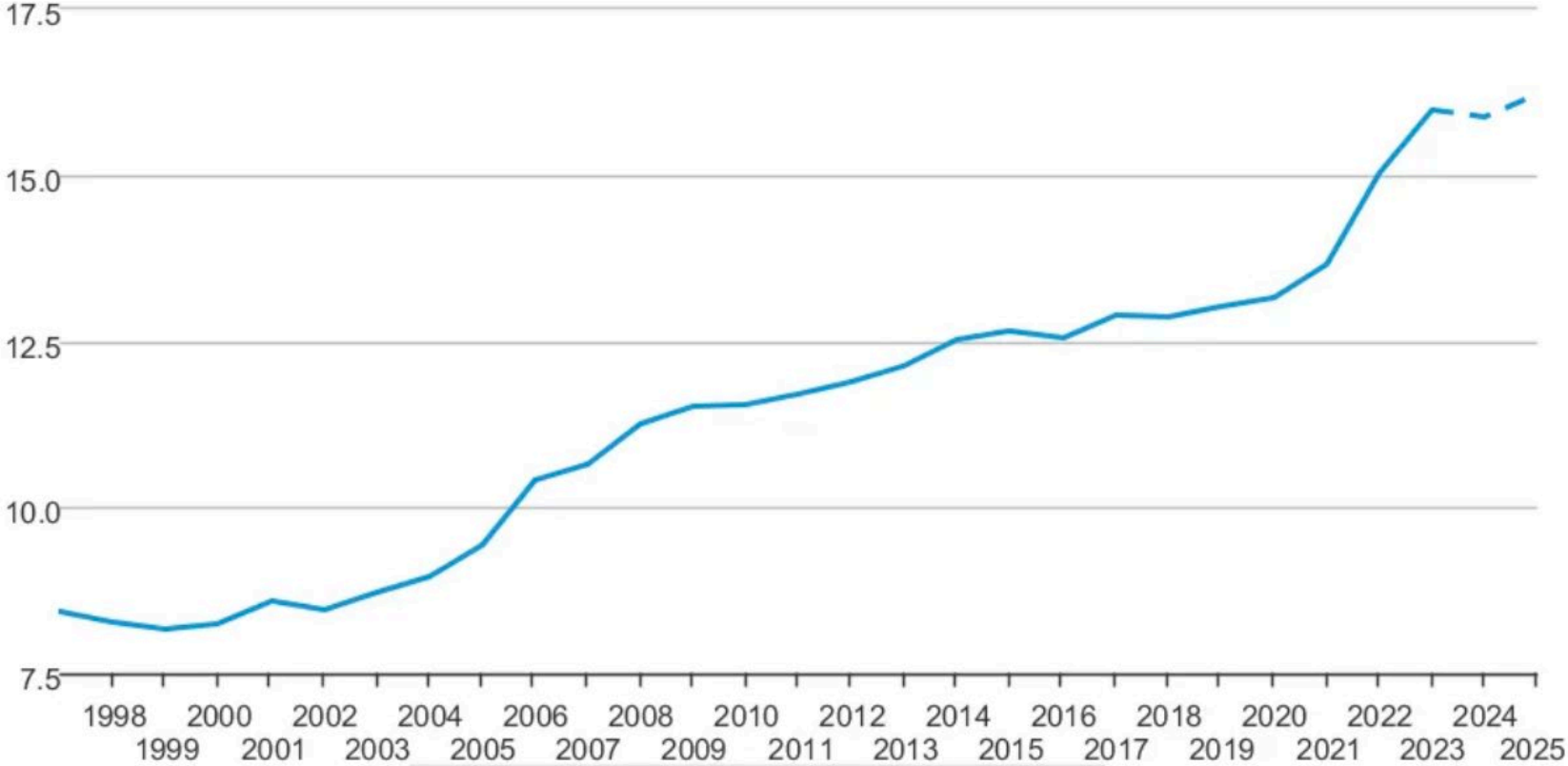
Headlines:

- Amid Explosive Demand, America Is Running Out of Power (Washington Post, March 7, 2024)
- AI Is Poised to Drive 160% Increase in Data Center Power Demand (Goldman Sachs, March 14, 2024)



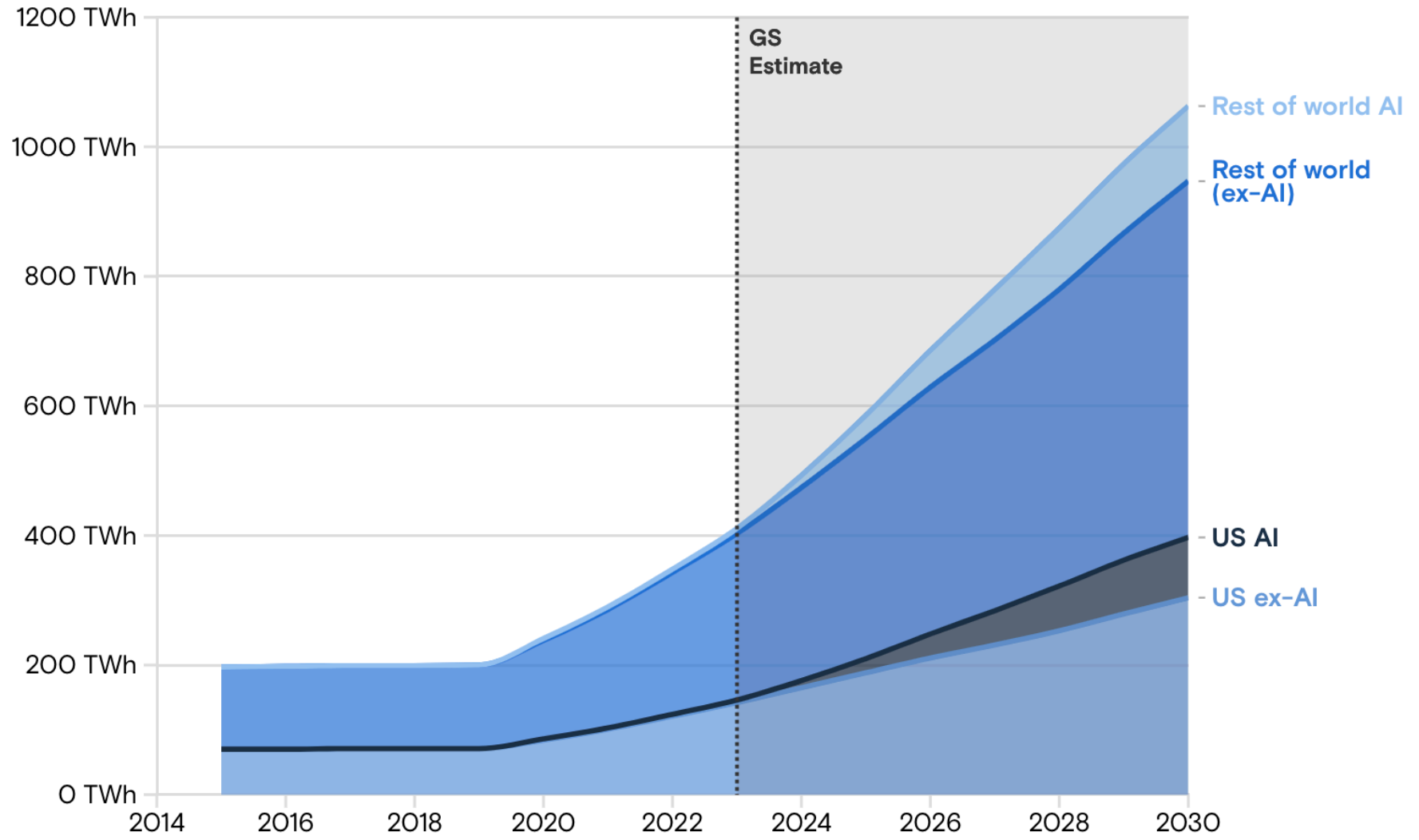
Electricity Residential Price: U.S. Average

cents per kilowatthour



Source: <https://www.utilitydive.com/news/us-electricity-prices-rise-customer-eia-outlook/710113/>

Data Center Power Demand: 2014 – 2030F



iea

Electricity Grids and Secure Energy Transitions

Enhancing the foundations of resilient,
sustainable and affordable power systems



“At least 3 000 gigawatts (GW) of renewable power projects, of which 1 500 GW are in advanced stages, are waiting in grid connection queues – equivalent to five times the amount of solar PV and wind capacity added in 2022.”

- International Energy Agency



“Computing accounts for about 1% of global electricity consumption today – we expect that to increase to 10% in ten years. [Autonomous] mobility could be a good share of that.”

- MIT Prof. Sertac Karaman

Industry Trend

AV 2.0: Gen AI, LLMs and Renewed Investment for Automated Mobility

Context / Description:

- The dance among Auto OEMs, Full Stack AV providers, and TNCs / Fleets (Uber, FedEx) continues
- LLM AI presents a new promise to finally overcome edge cases and corner cases

Headlines:

- Funding To Autonomous Driving Startups Surprisingly Starts To Move Again (Crunchbase News, June 25, 2024)
- Waymo's Robotaxi Rollout Is a Landmark Moment for Driverless Cars (Bloomberg, July 5, 2024)
- GM's Cruise abandons Origin robotaxi, takes \$583 million charge (TechCrunch, July 23, 2024)
- Super cheap robotaxi rides spark widespread anxiety in China (CNN, July 22, 2024)



Industry Trend

Growing Pains for Software Defined Vehicles

Context / Description:

- The personal car emerges as another connected personal device (with the phone, tablet, laptop ...) with software as a customer differentiator
- Vehicle architecture has shifted from mechanical-led platform to software-forward design
- Automotive OEMs are challenged to take on the role of lead software architect
- Just like batteries, SoC (System on a Chip) is increasingly viewed as “core business” for auto OEMs



Headlines:

- Ford CEO Explains Why Legacy Automakers Take Forever to Issue OTA Updates (The Drive, August 7, 2023)
- The World’s Biggest Carmaker Made a Huge Bet on Tech. Things Went Wrong Fast. (Wall Street Journal, Oct 28, 2023)
- Volkswagen’s \$5bn Rivian tie-up prompts dismay at software division (Financial Times, Sept 9, 2024)
- General Motors Quits Sharing Driving Behavior With Data Brokers (NY Time, March 22, 2024)

Social Trend

The Politicalization of Mobility: Values and Choices

Context / Description:

- Geopolitical tensions continue – especially with respect to China’s leadership in mobility electrification
- Within nations, opposing values polarize (and paralyze) policy

Headlines:

- Up to \$1 Billion May Go to Waste After Hochul’s Congestion Pricing Halt (New York Times, July 16, 2024)
- Mandated Anti-Speeding Tech for New Vehicles Begins in Europe (Forbes, July 1, 2024)



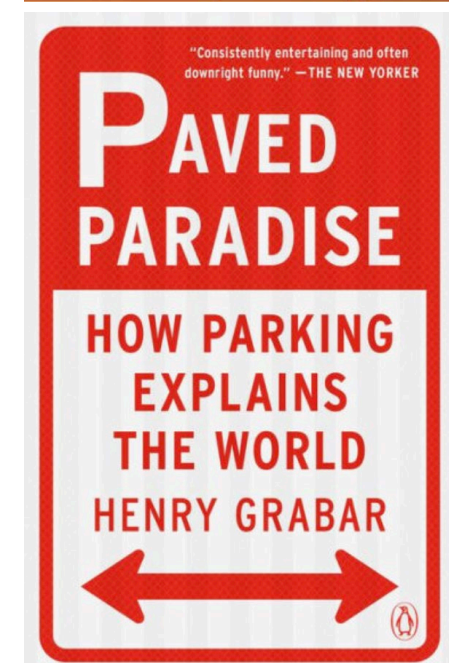
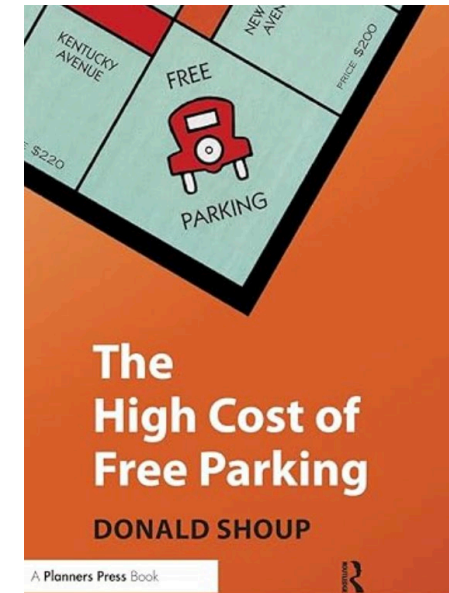
Parking Reform Goes Mainstream

Context / Description:

- Once the domain of urbanists and planners, a growing realization that parking matters
- Academics quantify the impact of parking minimums on housing costs, urban sprawl, energy consumption
- Many European cities took on parking in early 2000s; Paris announced plans to eliminate 70,000 on-street parking spots in 2020

Headlines:

- Austin Becomes Largest City in the US to Drop Parking Spot Requirements (Texas Tribune, Nov 2, 2023)
- Seoul Moves to Ban Overcharged EVs from Underground Parking (The Straits Times, August 10, 2024)
- New York and Cities Across the Country Reconsider Decades-Old Parking Rules (New York Times, October 18, 2024)



Post-Industrial Manufacturing Struggles with Strained Social Contract

Context / Description:

- The skills and capacity to make products – from facemasks to cars – are increasingly strained in developed nations
- Talent rushes to finance, entertainment and software; struggles to commercialize hardware
- Strained social contract and lack of trust in institutions

Headlines:

- Ford Falls Most in 15 Years as Warranty Costs Erode Profit (July 24, 2024)
- Muni Estimates That More Than 20% of Riders Aren't Paying (San Francisco Chronicle, April 12, 2024)
- Boeing Machinists Reject Contract, Extending Strike (Wall Street Journal, October 24, 2024)
- Kyoto Bus Operator Declares “State of Emergency” Due to Driver Shortage (The Mainichi, October 1, 2024)



Social Trend

The Mobility Divide Grows?