# Generate's Expert View

# Where are we in the energy transition?

Generate Capital, Head of Research, Logan Goldie-Scot

As we head into a new year, our experts at Generate reflected on the state of the projects and businesses we invest in and the impact of real and perceived headwinds on our sector's ability to thrive. This comes as the transition to a sustainable economy meets the transition from a period of financial exuberance to a period of fiscal realism. What follows is the collective insight of our team.

Scott Jacobs

Bill Sonneborn

Ed Bossange

Jeff Ross

Jonah Goldman

Nam Tran Nguyen

Sarie Lovell

Andrew Hughes

Christian Okoye

Eric London

Gopal Vemuri

John Dannan

Katie Treuer

Matt Lugar

Peggy Flannery

Pietro Lomazzi

Scott Gosselink



GENERATE

# A foreword

The years of irrational exuberance are over, but instead of despairing we should be thankful for them. It allowed us to invent things we needed, to invest in things that wouldn't have drawn investment, and to pass policies that have moved us forward materially. Much of what was invested in will survive in a more rigorous structure and will fit into the investable, bankable economy that we're helping to build. Some of it will not. In the midst of CleanTech 1.0, in 2005, $51 billion was invested globally in energy transition. Since 2021 global energy transition investment has been counted not in billions, but in trillions. The market has progressed massively, but this means that bankruptcies and failures will also be bigger.

The climate world oscillates between unhelpful optimism and unrealistic pessimism that forces it into these corners that are unproductive, unrealistic, and uninvestable. Exuberance and despair may define the edges, but most good business and investing takes place in a stable core. The policy signals are dependable as we laid out in our August Generate:Intelligence expert view, the capital markets are cautious but supportive, and good businesses continue to succeed. We are moving through a moment that all industries move through where the end of exuberance is the beginning of identifying the survivors. Those with good fundamentals will win and those who understand the opportunities will win.

To make sense of this point in the transition, we highlight some optimistic signals and reasons to be cautious as you prepare for 2025. They build on our capital formation, operations and investment expertise derived from a decade of successfully investing in the energy transition across North America and Europe.

# The elephant in the room

This year, the world questioned the durability of the policy landscape which has enabled major investments in sustainable infrastructure. The US election was historically fractious, and cracks emerged in political coalitions across Europe.

Can the market-shaping frameworks developed through local, national, and multilateral processes during the giddy years of 2020-2023 withstand criticism that they were inflationary, restricted resources, and harmed local economies? In short, yes. The death of green policies has been exaggerated as the flows of capital into real projects and local economies to support these industries has made them locally popular even while they seem nationally vulnerable.

To be sure, the transforming landscape will mean changes to investment activities as new and emerging governing powers seek to put their mark on the transition. In the US, where the incoming Trump Administration has been rhetorically hostile to the energy transition, some of the incentives will go away but most are likely to endure, even if their contours will look different. It is a reminder that the infrastructure transition does not represent a single asset class that is easily defined, but a broad physical economy that has attracted trillions in investment.

As we mentioned in our expert view after the election, sustainable infrastructure capital flows protect policy structures by investing in the things that work for communities, answer customer demands, and make sense economically. That won't change. While there will be movement on the margins, the core set of incentives that the infrastructure transition has relied on remains intact and politically durable across jurisdictions.

A deregulatory push more broadly could also unlock banks' lending capacity, benefitting capital intensive areas such as sustainable infrastructure. Uncertainty around Basel III Endgame requirements have for instance lingered over the US tax equity market since the implementation proposals came out in July 2023. These efforts now appear dead.

# The highlights

The opportunity: We need to rebuild the physical economy of the United States. A failure to account for the overwhelming technological progress and clear global regulatory direction during this rebuild threatens the nation's economic and geopolitical leadership.

Capital markets: Exit activity and distributions are subdued, leading to more competition for capital. The age of free money is over, prompting a flight to quality.

A new era of load growth: After decades of flat growth, we are entering a new era. The 5-year load growth forecast has increased ≈5x in the last two years. It is simultaneously a boon for clean power and could, if managed poorly, imperil several emerging technologies while locking in large-scale natural gas for decades.

A bumper year for storage. Annual front-of-meter installations of US battery storage to hit 10GW in 2024, 10x of 2020 installations.

Turning the corner on T&D: Transmission expansion and IQ reform, is underway. Some processes will be slow, others quick. DG can play a key role, today.

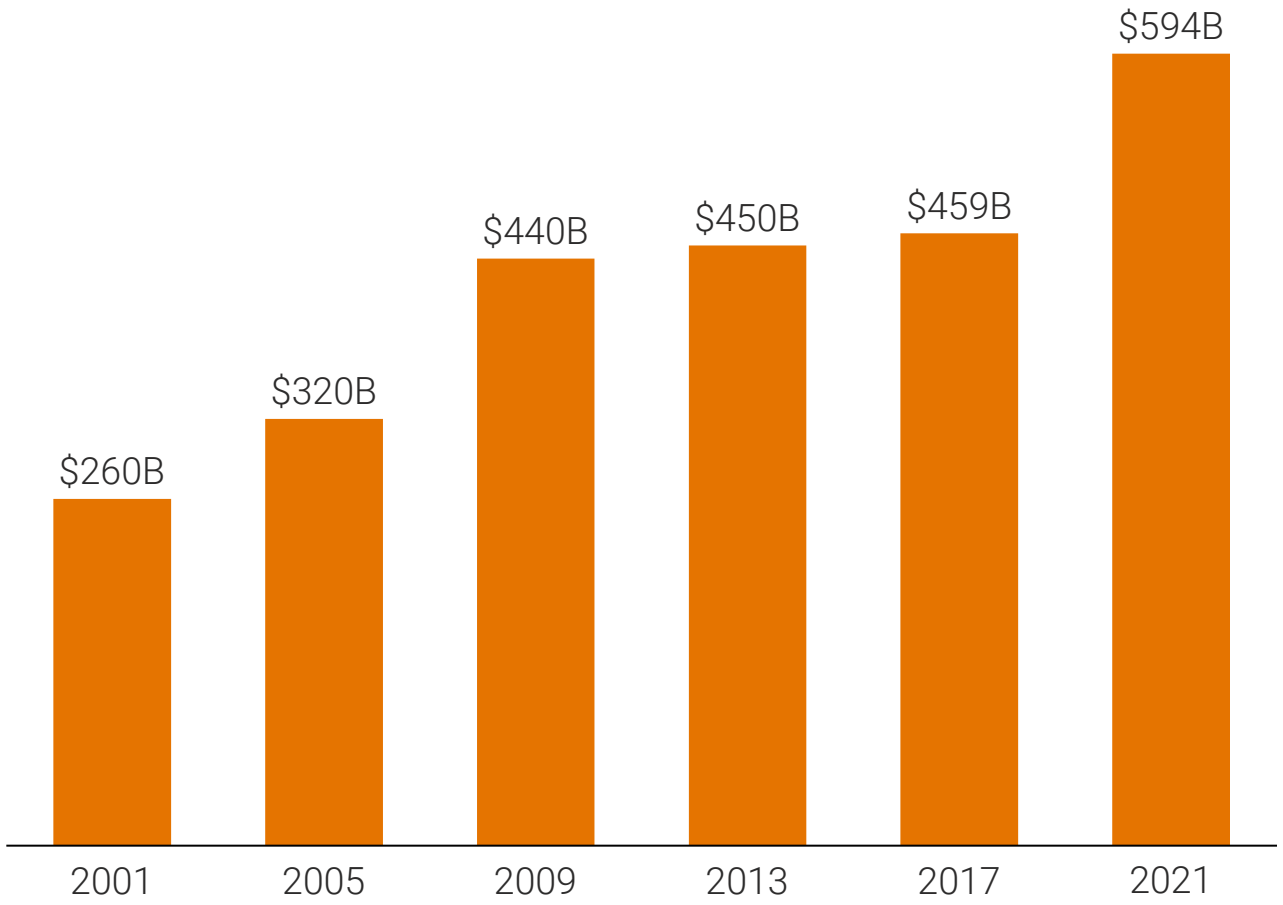
Troubled supply chains, new opportunities: The US has rediscovered its manufacturing mojo, which is both an investment opportunity and a way to manage tariff and broader geopolitical uncertainty. Technology improvements and cost reductions remain a global story, keeping imports an option.

Green shoots for RNG: The outlook for Renewable Natural Gas from food or dairy waste is looking brighter, helping utilities and corporations decarbonize.

Mobility: Electric buses from our clean bus JV are already enroute to school districts, and the outlook for passenger EVs is rosier than many believe.

# The opportunity. US infrastructure is ageing and crumbling, with a massive amount of retirements over the coming decade. We must be resourceful with capital when rebuilding the physical economy, focusing on best-in-class, low carbon assets.

ANNUALIZED COST TO IMPROVE AMERICA'S INFRASTRUCTURE[1]




C-

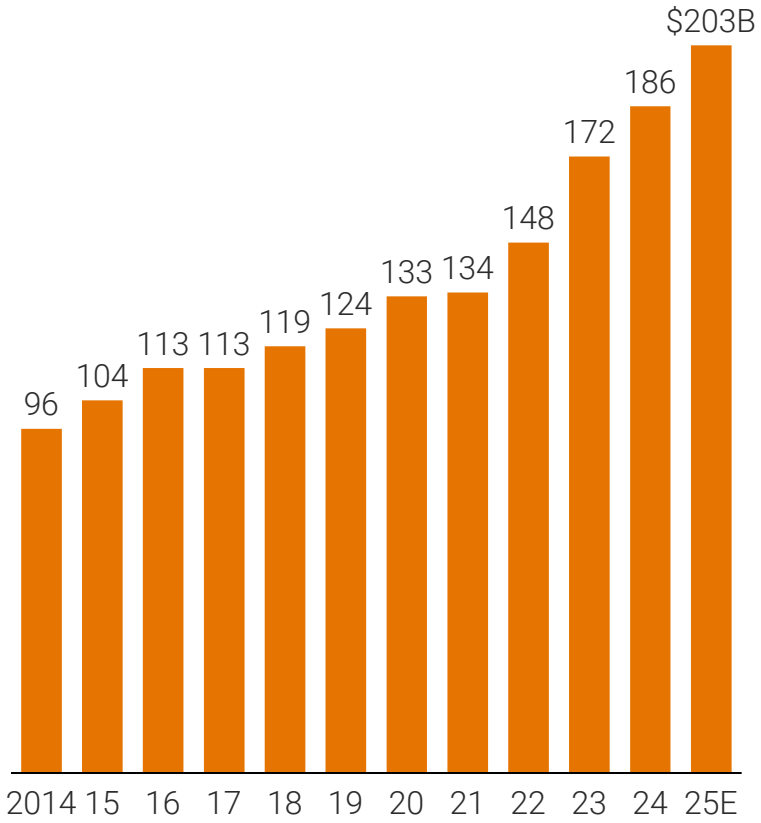
2021 Infrastructure grade*



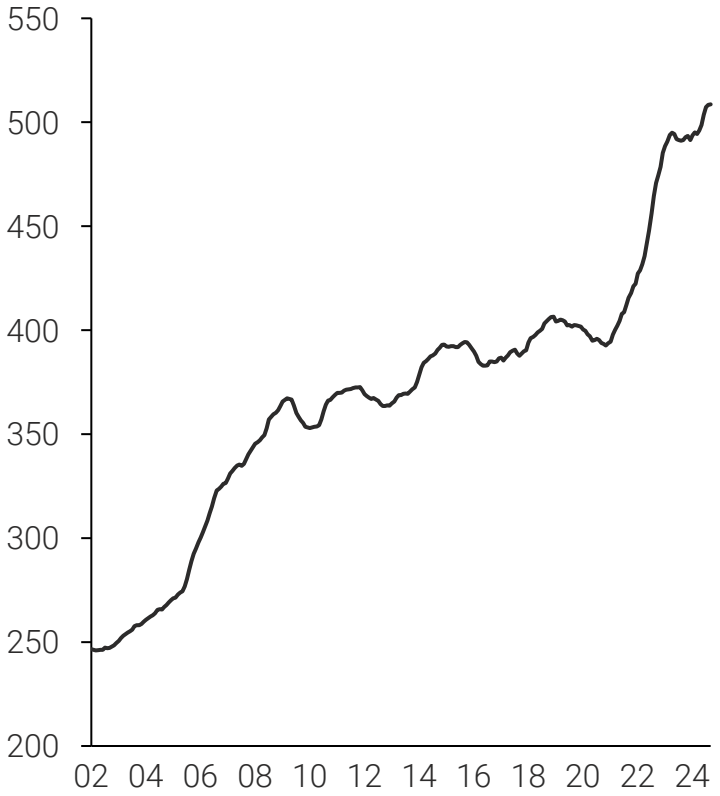
1 ASCE Infrastructure Report Card. X-axis based on report card year. Total "cost to improve" data has been annualized to allow a comparison across reports. * A C- is the first time in 20 years US infrastructure has been higher than in the "Ds".

# “Almost 600,000 people invest $200 billion a year, receive $500 billion in revenue, and operate a $2 trillion machine that provides the essential energy input of our built environment, our technology system, and increasingly, our transportation and industry systems as well […] This big system also needs to keep getting bigger.”[1]

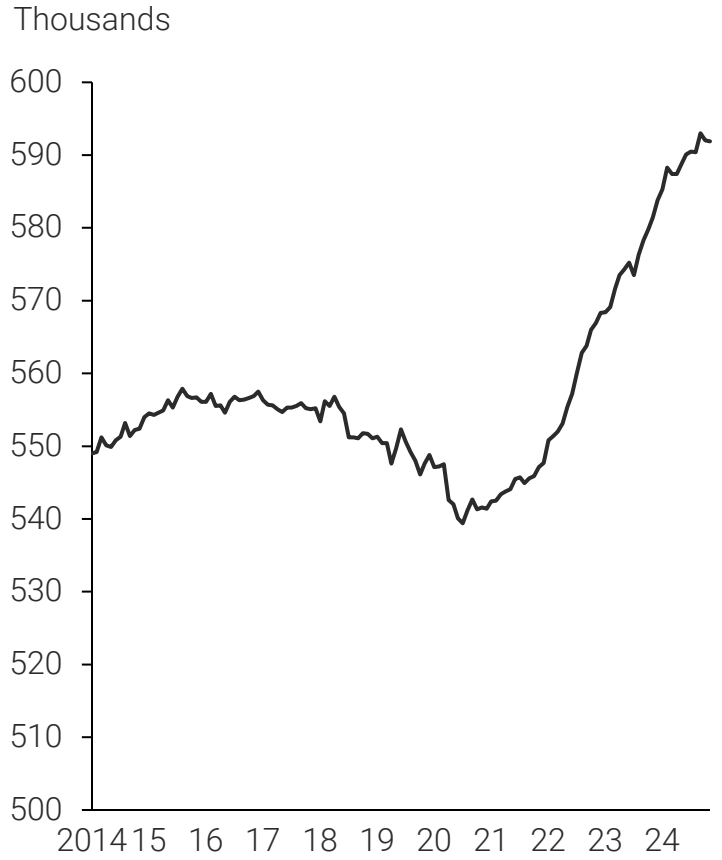
US INVESTOR-OWNED UTILITY CAPITAL EXPENDITURES ($B)[2]




US RETAIL SALES OF ELECTRICITY ($B, TRAILING 12 MONTHS)[3]




US UTILITY EMPLOYEES[4]

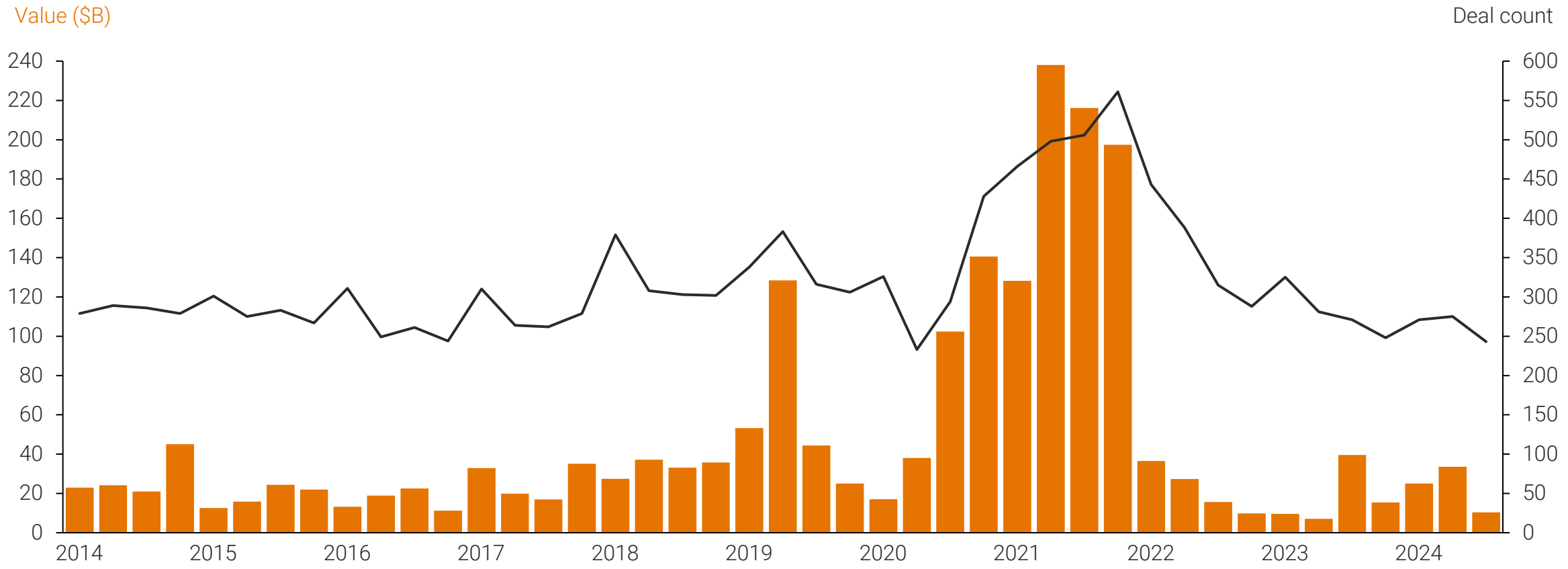



Source: [1] Quote and chart inspiration from Nat Bullard’s December Halcyon post “Bright Lights and Big Numbers”; [2] EEI; [3] EIA ; [4] BLS. Note: Utility employment is only part of the story: the 2024 USEER shows that the energy workforce overall added over 250,000 jobs in 2023; 56% of those were in clean energy (DOE).

# Capital markets

# What happened? Exit activity remains subdued and infrastructure distributions have dipped[1], increasing pressure on companies and investors alike as capital expenditure needs grow

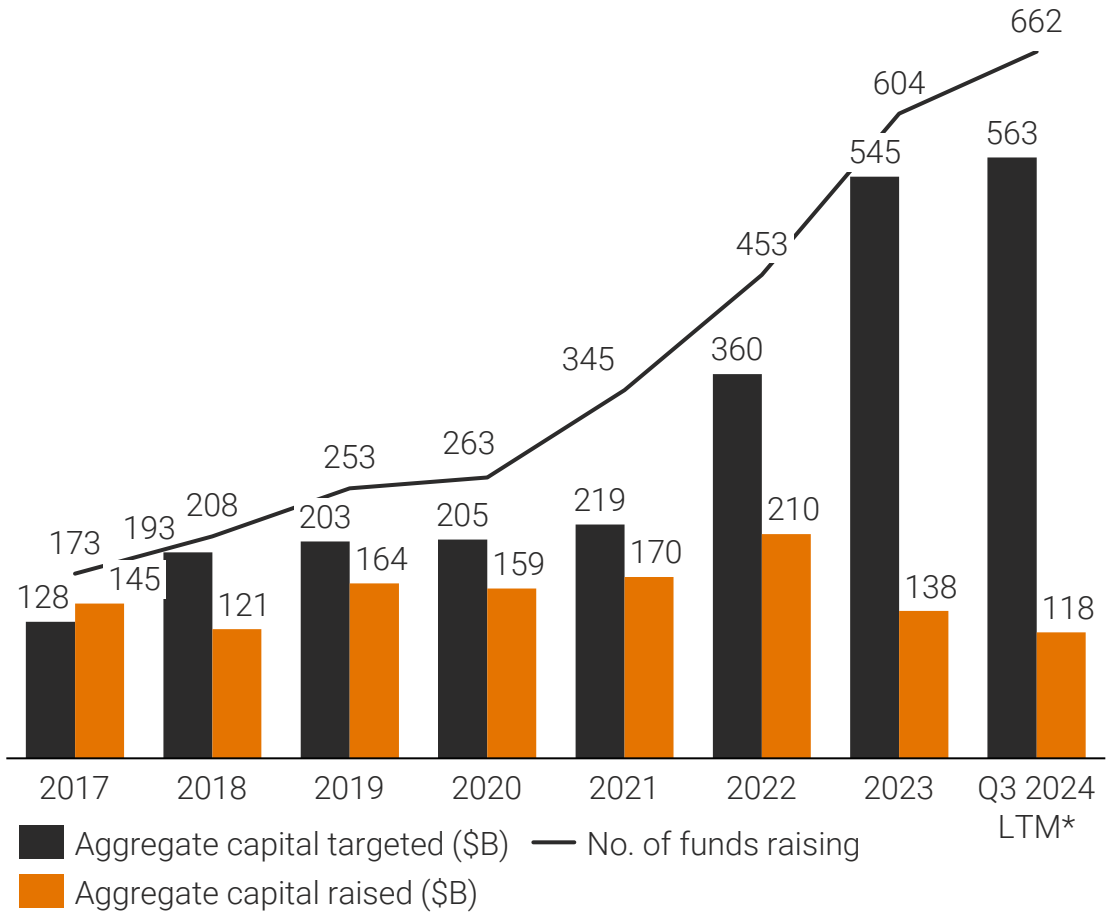
US VC EXIT ACTIVITY BY QUARTER [2]



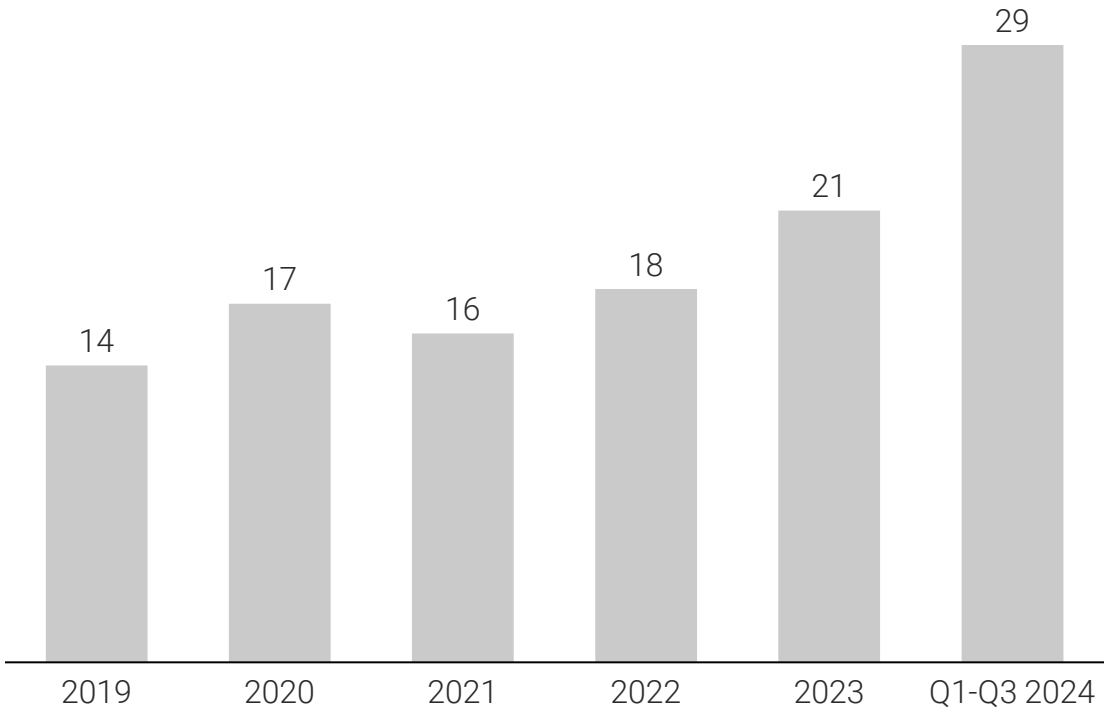

 [1] Hamilton Lane, Campbell Luytens, [2] NVCA Venture Monitor

# A point of caution. More funds are competing for the same capital, average time on the road is up, and only those with proven capabilities will succeed

AMOUNT OF CAPITAL TARGETED VS. AMOUNT RAISED ($B)[1]



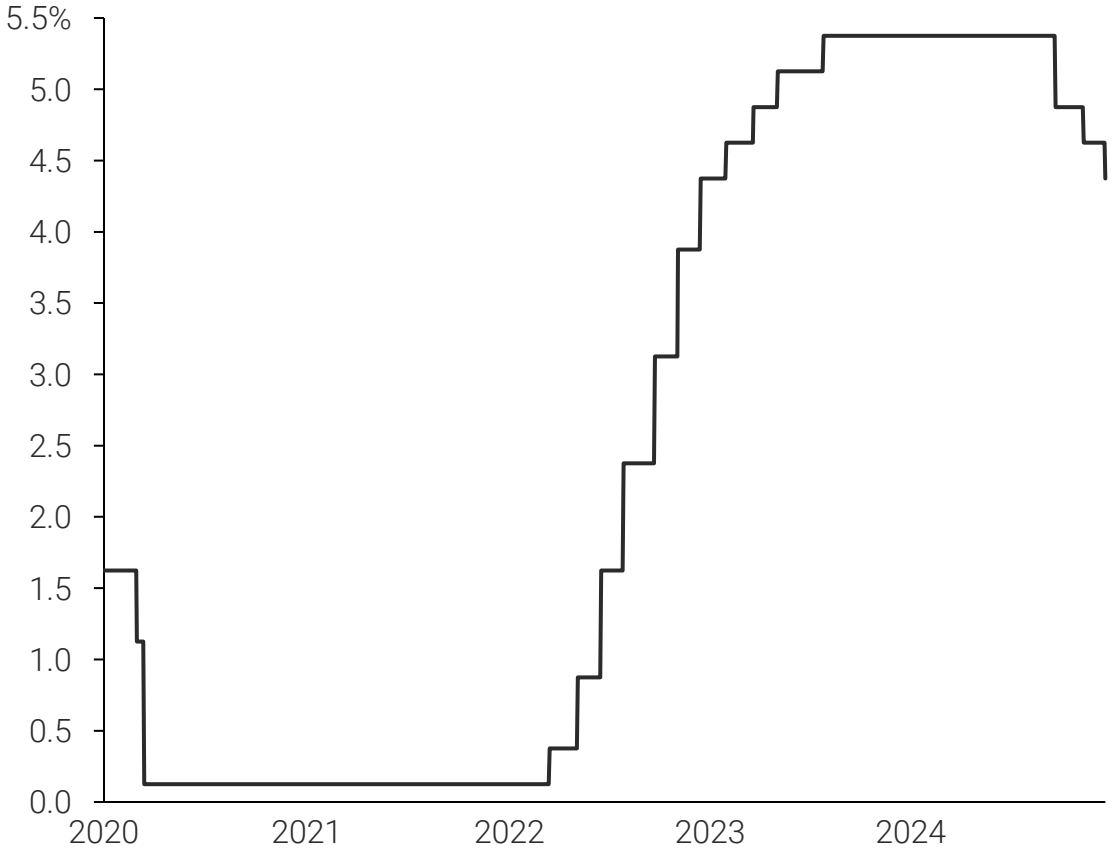

AVERAGE TIME ON THE ROAD FOR FUNDS CLOSED (MONTHS)[2]




 [1] Preqin, Campbell Luytens. Shows Unlisted Funds. * This metric uses the trailing LTM as a proxy for YE 2024. [2] Infrastructure Investor.

# A point of caution. In December the Federal Reserve cut rates again but signaled fewer cuts to come in 2025. Lower rates equal lower borrowing costs for renewable energy developers. Meanwhile, the yield on the 10-year Treasury Bond continues to rise due the possibility of higher inflation and tariffs, among other things

US FEDERAL FUNDS TARGET RATE

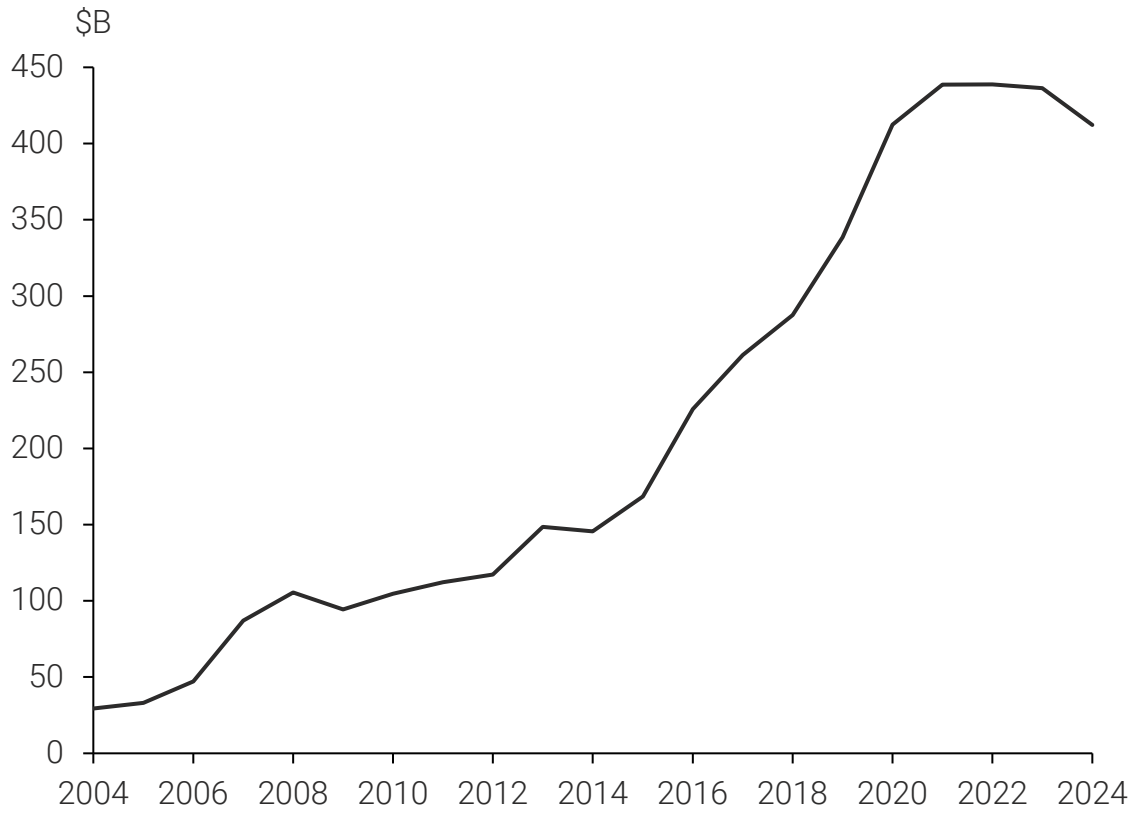



YIELD ON US TEN YEAR TREASURY BOND

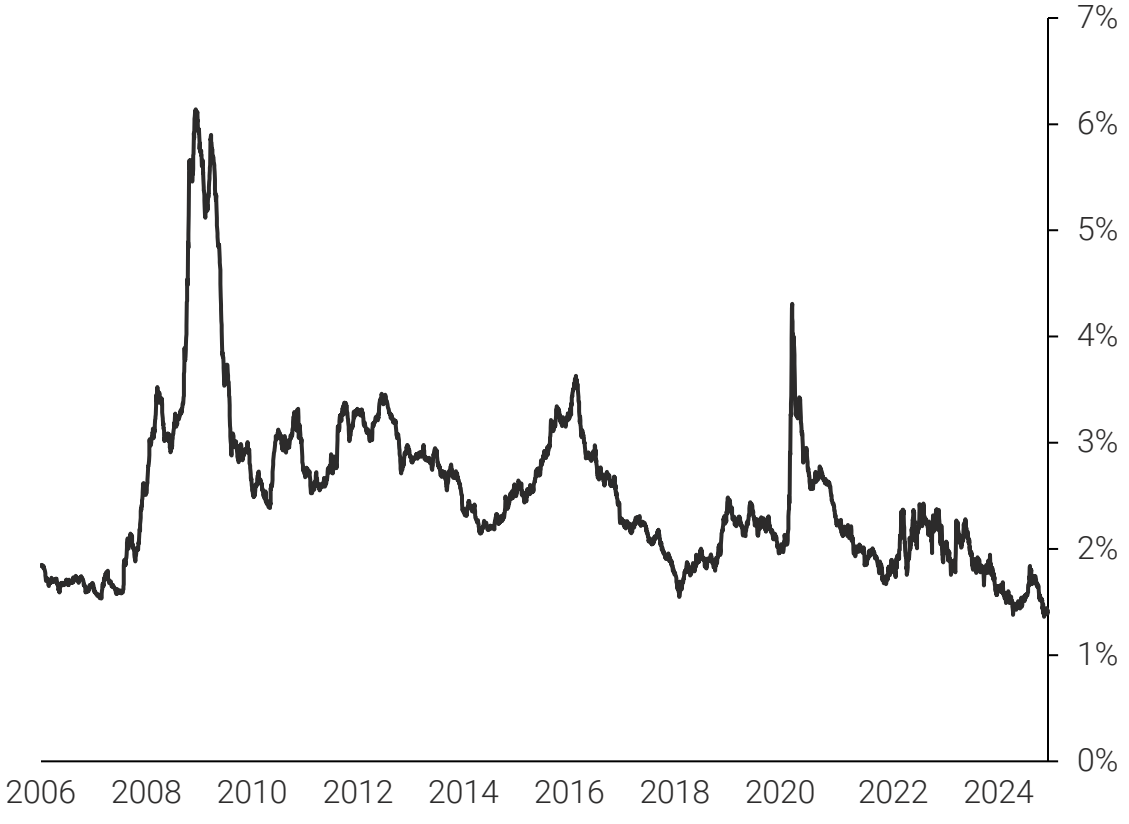

 Source: Bloomberg, The Federal Reserve. Note: Based on the midpoint of the federal funds target range.

# An optimistic note. Plenty of infrastructure and private debt dry powder is available and renewed market optimism will ensure good companies are funded. Higher transaction volumes in M&A and public markets will boost private sector sentiment.

NORTH AMERICA INFRASTRUCTURE AND PRIVATE DEBT DRY POWER[1]




YIELD SPREAD BETWEEN BAA CORPORATE AND TREASURY BONDS[2]






[1] Preqin. [2] Grayson Hoteling, Longertermtrends. Note. A blowout in credit spreads coincides with major economic events over the lifetime of US equity markets. Peaks in the spread occurred in the 1970s/80s recessions, the dot-com bubble in 2000, the 2008 financial crisis, and COVID.

Our role. A flight to quality, and to impact, is underway. We need to make sure firms sustain, and in some cases rebuild, confidence from the capital markets in the energy transition. This relies on proof, not promises.

Jan. 31, 2024, 3:00 AM PST

## Generate Capital Raises $1.5 Billion from Calstrs, Hesta, QIC

## Generate Capital Secures $1.2 Billion Corporate Credit Facilities to Drive Sustainable Infrastructure Growth

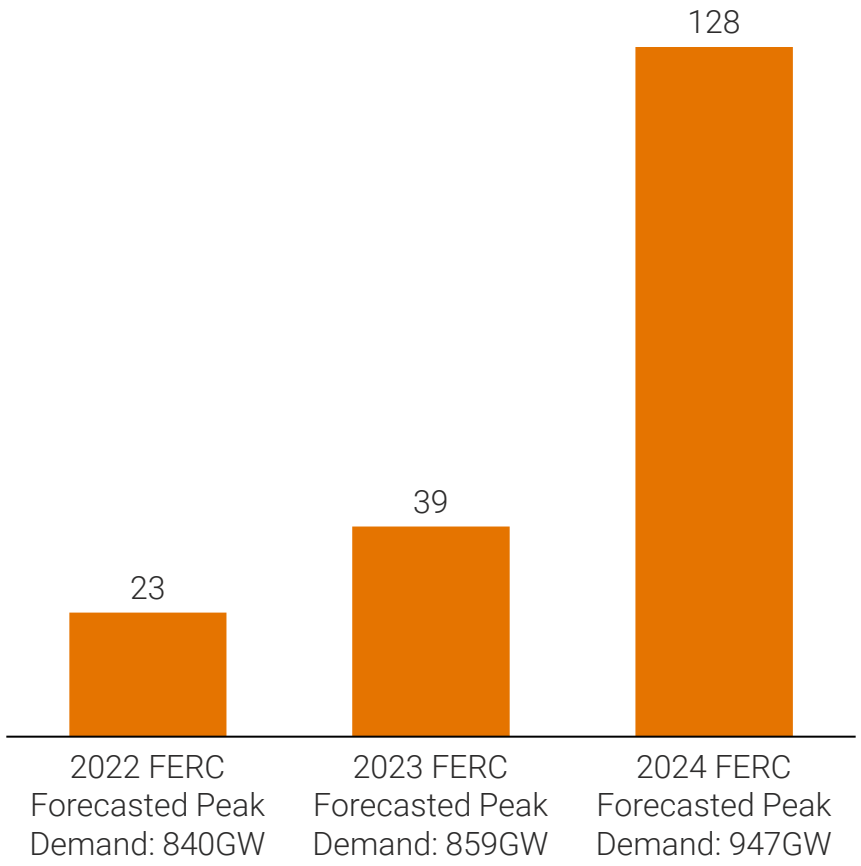
Business Wire Nov 20, 2024

# Data Centers

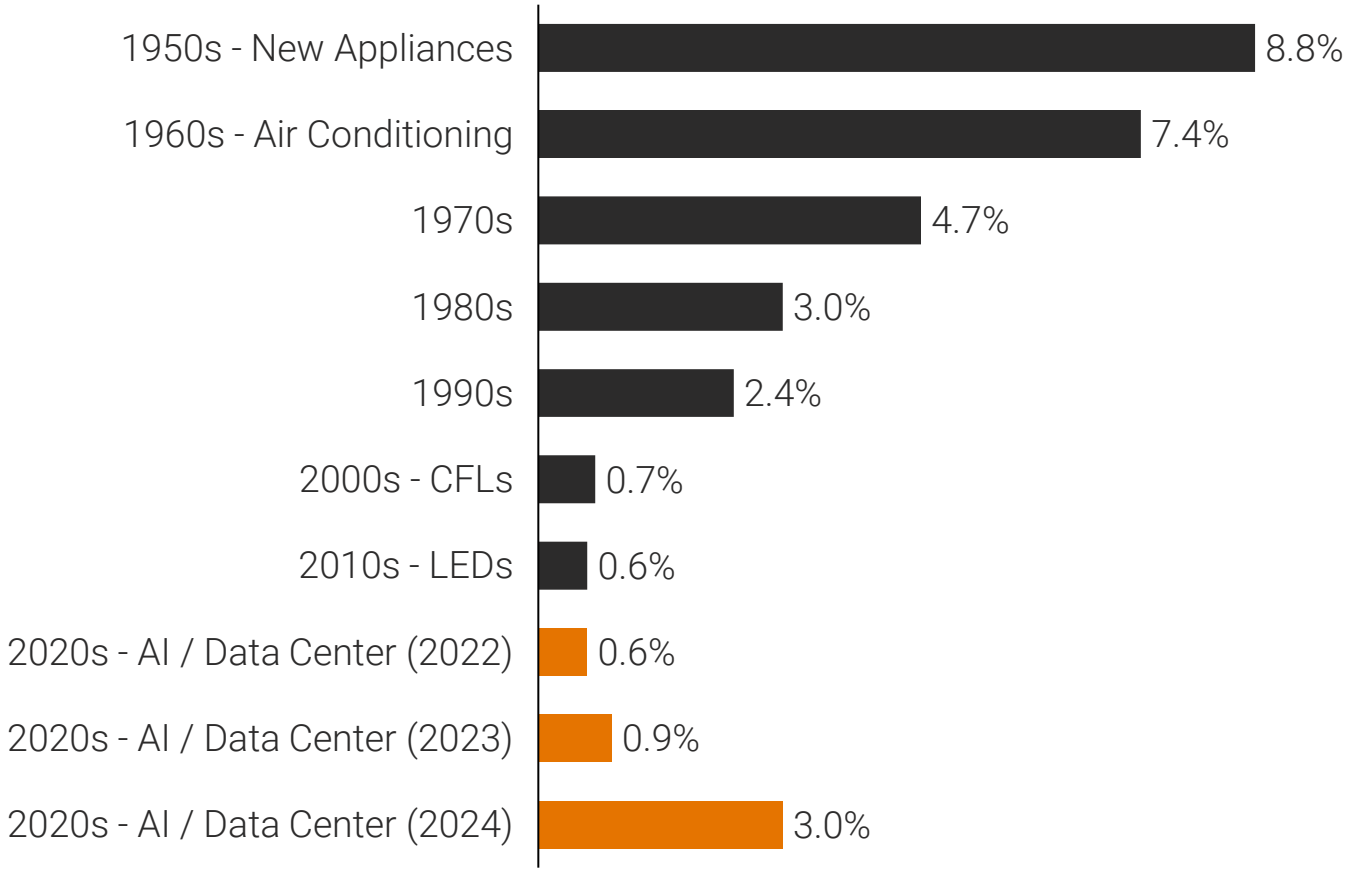
## AND BROADER LOAD GROWTH

# What happened? The 5-year load growth forecast has increased ≈5x in the last two years. After decades of flat growth, we are entering a new era.

5-YEAR US NATIONWIDE GROWTH FORECAST (GW)[1]



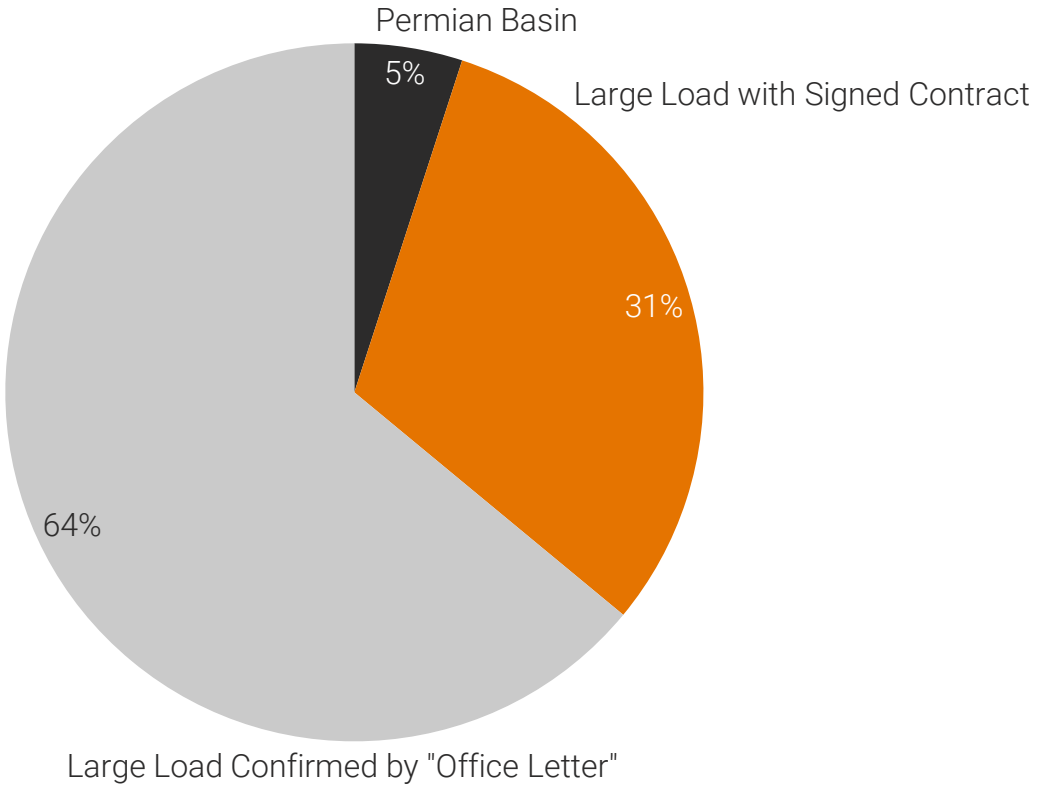

AVERAGE ANNUAL LOAD GROWTH[1]



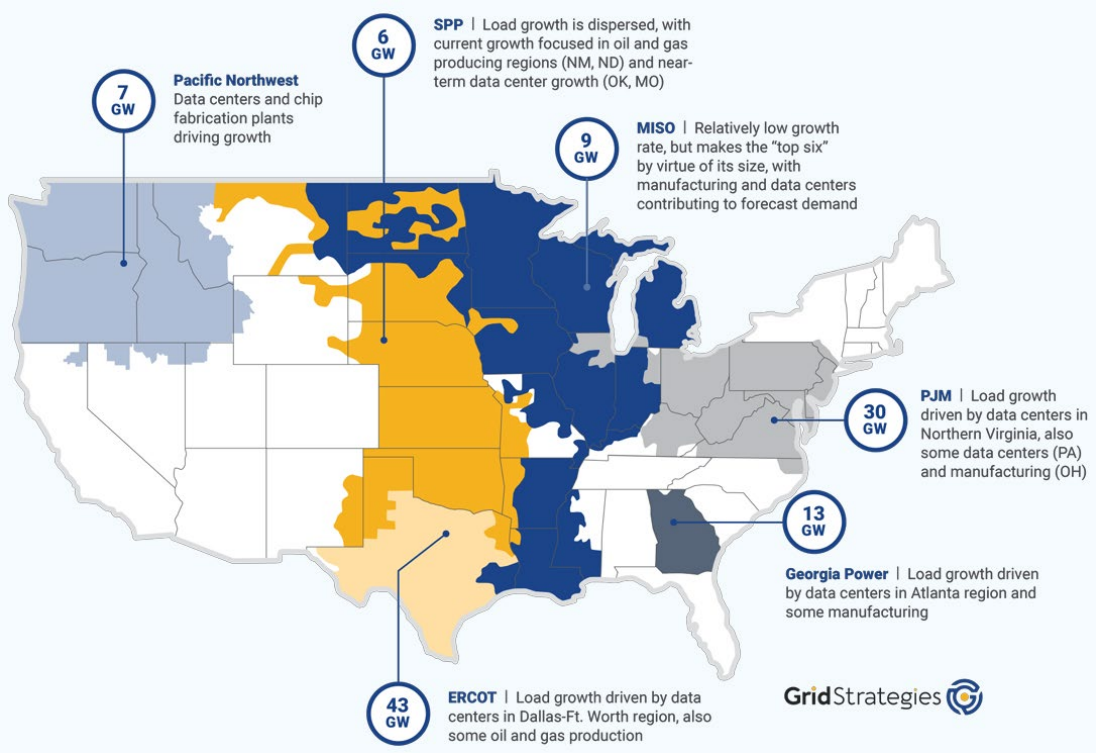

 [1] Grid Strategies. Note: 2024 forecast includes 61GW of growth based on recent update reports, estimated by Grid Strategies

# A point of caution: many estimates are not bound to firm commitments, are highly geographically concentrated, and much will likely not materialize. At least not on time. We're at the start of something important, but we don't yet know what. Strong partnerships with customers are key to gaining visibility and making an impact.

ERCOT SOURCES OF LARGE LOAD GROWTH ESTIMATES[1]




REGIONAL BREAKDOWN OF LOAD GROWTH THROUGH 2029[1]





[1] Grid Strategies, ERCOT, The Texas Energy and Power Newsletter. Note: ERCOT's own projections are higher than the Grid Strategies estimates

# A point of caution. Data center demand threatens emerging business models reliant on access to cheap, clean power but with less cash


> "We've seen growing competition for clean power amongst industries that are emerging much faster than anybody would have ever predicted."

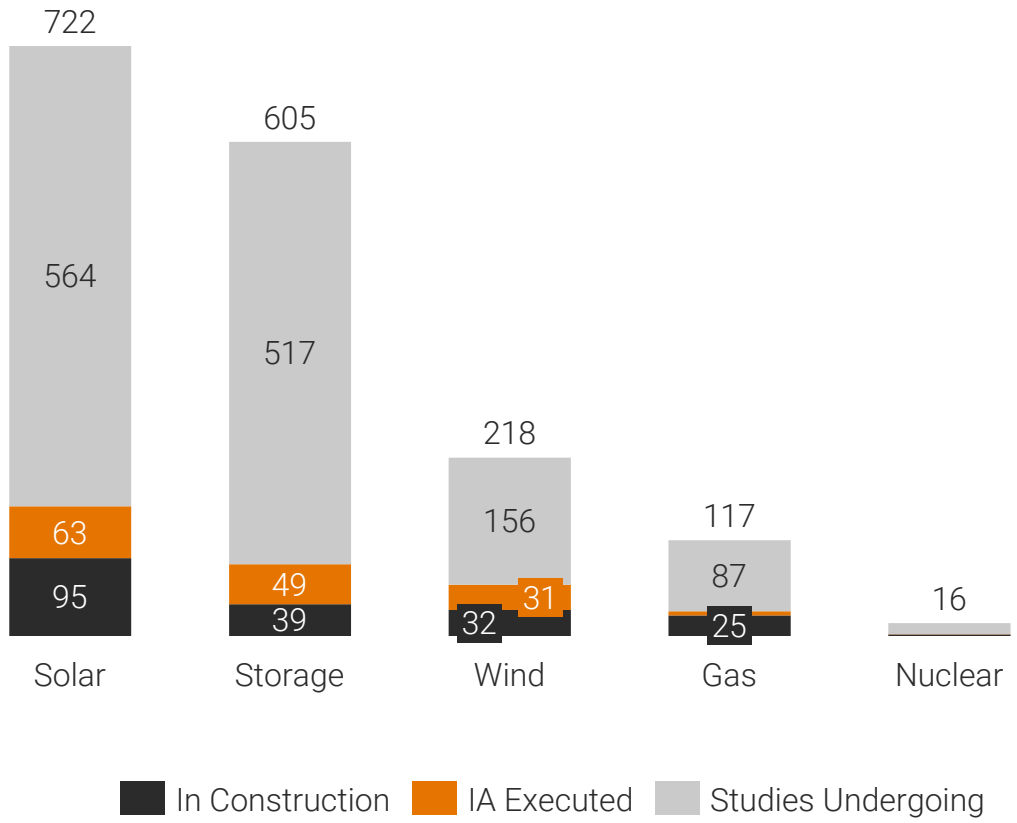
CarbonCapture CEO Adrian Corless

 Source: E&E News

# An optimistic note. Over 90% of the advanced US interconnection queue is made up of clean power and is well placed to meet new demand.

Demand growth is good for renewable energy developers and asset owners. But it is a mixed story for emissions goals as it also creates a need, and sometimes simply an excuse, for large-scale natural gas. Water availability, lagging queue positions, challenges with the gas supply network, a history of boom-and-bust merchant gas in the US, and the risk of shrinking capacity factors in the face of more clean power may moderate gas-build down from gas-announced. Even so, some ISOs are proposed to fast track projects through the queue, with a ranking that heavily favors gas.[2]

US ADVANCED INTERCONNECTION QUEUE CAPACITY BY STATUS (GW)[1]




**Why won't PJM let batteries and clean power bolster a stressed-out grid?**

The country's biggest grid operator is preventing developers from adding batteries to existing projects that have extra grid space, in defiance of a federal mandate.

By **Jeff St. John**
3 October 2024

**Renewable energy developers urge PJM to drop fast-track interconnection plan**

The PJM Interconnection's proposed Reliability Resource Initiative, if approved, will be challenged at the Federal Energy Regulatory Commission and in court, the developers said.

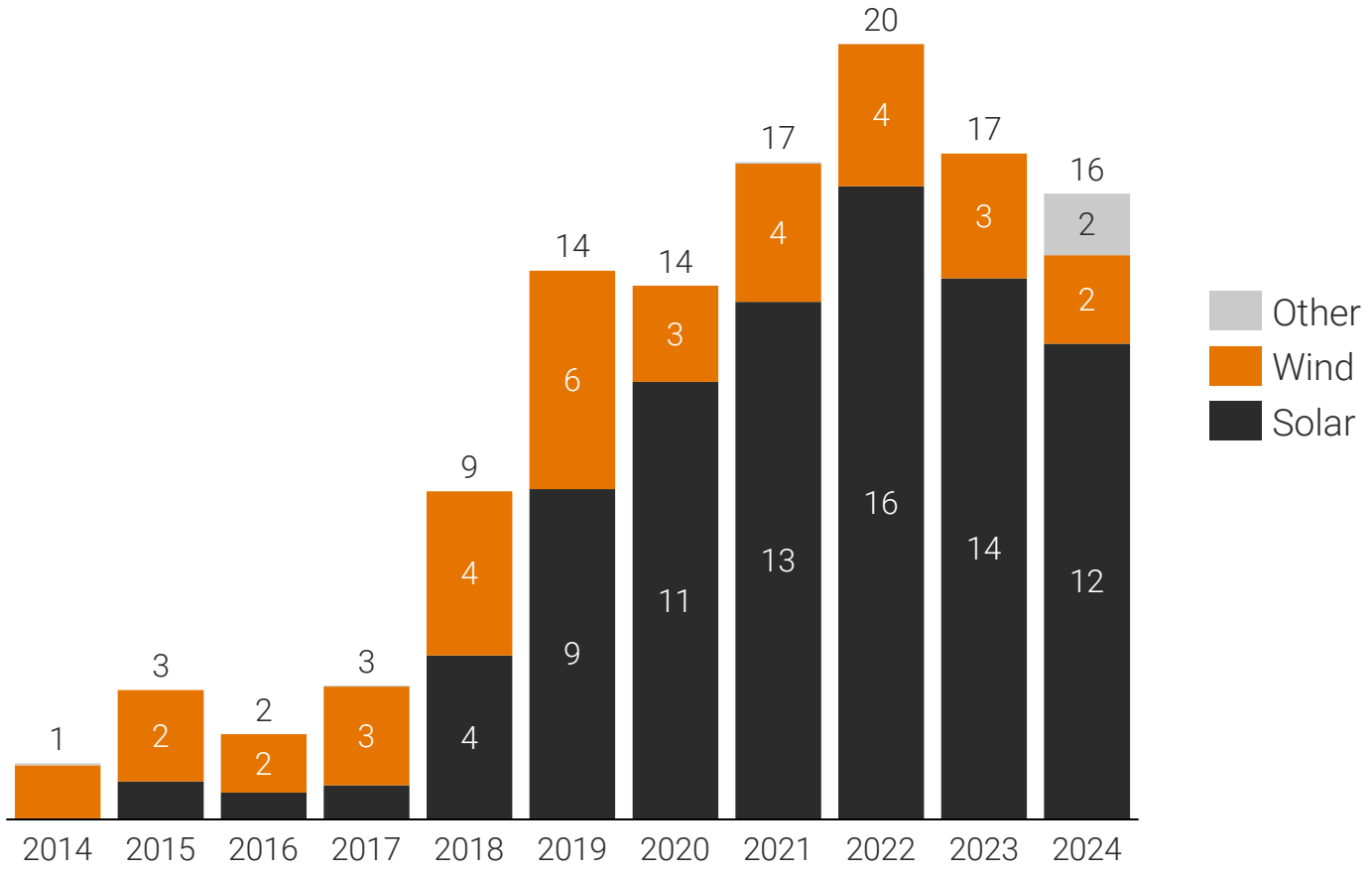
Published Dec. 4, 2024

**MISO Tells Board RA Fast Lane in Interconnection Queue is a Must**

 [1] Orennia, [2] E&E News

# Corporate demand for clean power remains healthy, with global year-to-date volumes tracking higher than in 2023. Solar and wind remain strong while US technology companies have also given fresh momentum for advanced geothermal, and nuclear. Even the Meta-Entergy gas deal has a clean power matching commitment.

US CORPORATE PPA VOLUMES[1]




**NV Energy seeks new tariff to supply Google with 24/7 power from Fervo geothermal plant**

**Google, Kairos Power ink 500-MW advanced nuclear reactor deal**

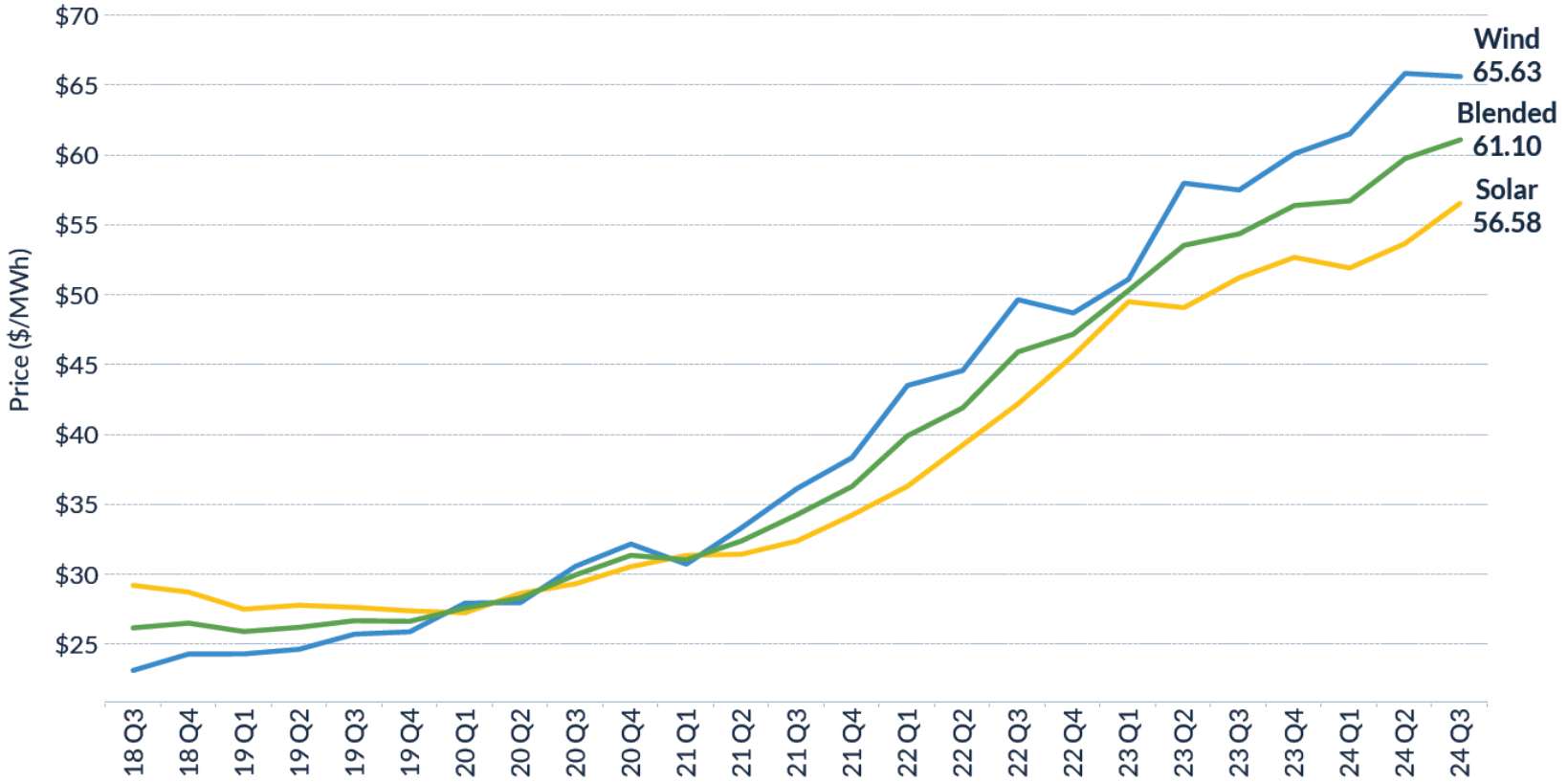
**Meta seeks up to 4 GW of new nuclear power to help meet AI, sustainability objectives**

**Three Mile Island nuclear plant will reopen to power Microsoft data centers**


[1] BloombergNEF. Note: Tracking PPAs up to and including November.

**This is despite PPA prices continuing to rise.** A transition from the 'roadmap' phase of decarbonization to 'execution' phase is underway. Many companies spent years whiteboarding how ambitious sustainability goals can be achieved. We are now seeing companies take tangible action towards achieving these goals, and opening wallets.

MARKET-AVERAGED CONTINENTAL INDEX PPA PRICES[1]




 [1] Level Ten

Our role. In addition, and often alongside, large-scale wind, solar and storage, many customers need lower carbon microgrids, onsite power, and energy efficiency solutions. We help make these offerings compelling to a customer, while continuing to accelerate the decarbonization potential of these technologies.

**Meta signs credits deal for Pine Gate's 204-MW solar project in Texas**

May 23, 2024, 5:52:22 PM | Article by Sladjana Djunisic

**Bloom Energy Announces Gigawatt Fuel Cell Procurement Agreement with AEP to Power AI Data Centers**

OpenAI Data Center Provider Crusoe Raises $600 Million

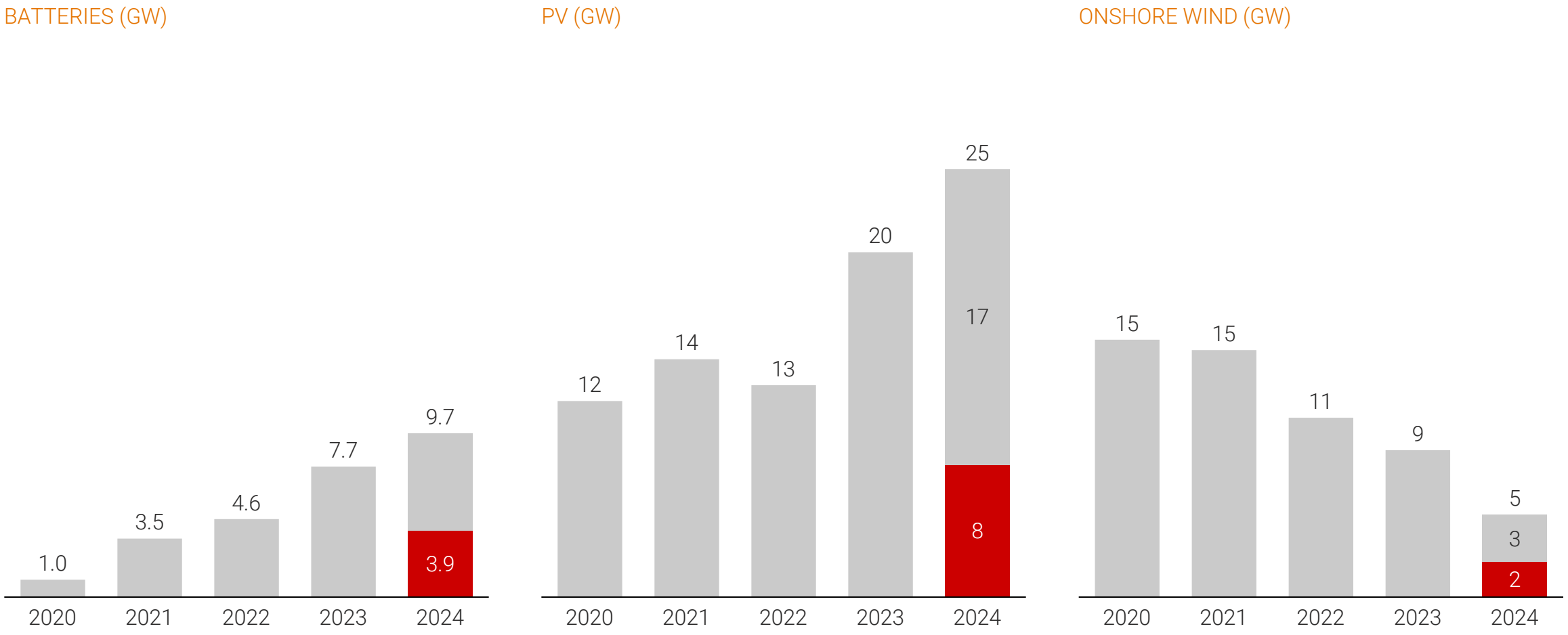
ENCHANTED ROCK IS USING RNG TO POWER A MICROSOFT MICROGRID IN SAN JOSE


 Source: Data Center Dynamics (right image)

# Energy storage

# What happened? Annual front-of-meter installations of US battery storage to hit 10GW in 2024, 10x of 2020 installations and 2x greater than 2024 wind installations

ERCOT: The momentum of the market overwhelms the objections of policy makers.[1]

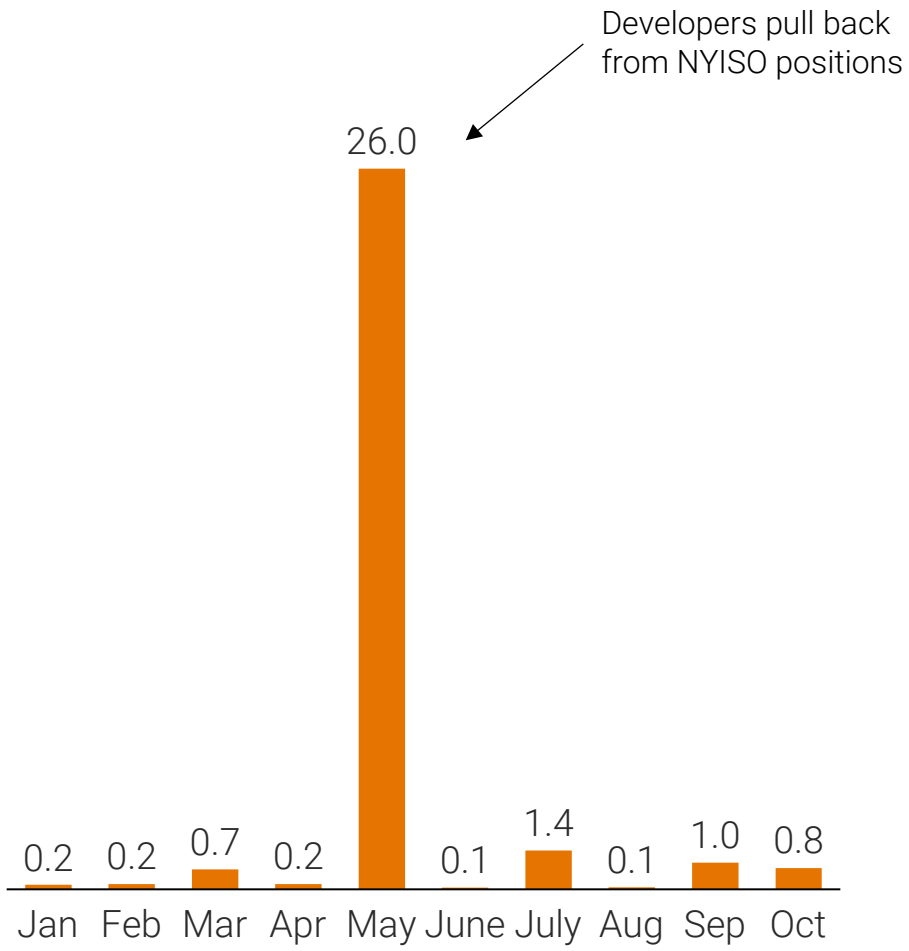





[1] H/t Azeem Azhar. [2] Source: Orennia. Note: Year based on First Power Date. Status filtered for operating and under construction projects. This represents the low end of 2024 forecasts, with BNEF estimating 34GW of utility-scale PV, 7GW of wind and 11.5GW of utility-scale storage in 2024.

# A note of caution. Questions remain as to which new US front-of-meter battery storage market will open up in the near-term as MISO, NYISO and SPP all face issues

2024 ENERGY STORAGE CAPACITY WITHDRAWALS IN NYISO



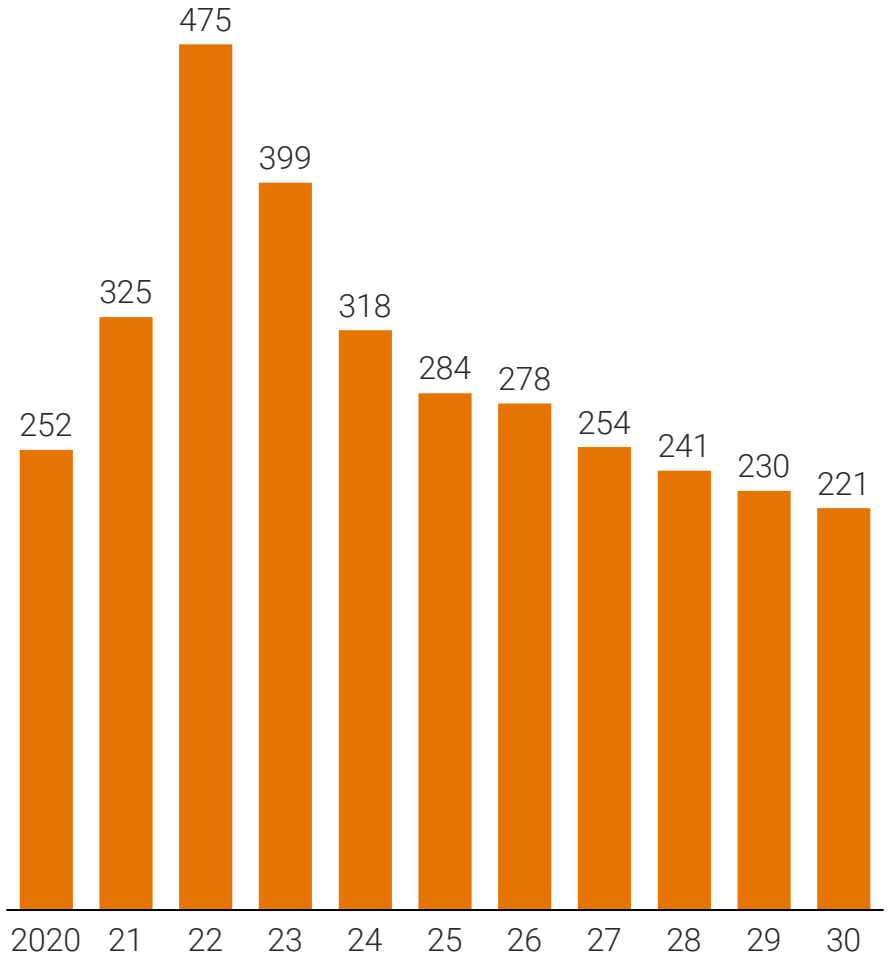

**MISO to Skip 2024 Queue Cycle While it Automates Study Process with Tech Startup**

**Southwest Power Pool seeks FERC OK to delay 2024 interconnection queue process**

 Source: Orennia

# An optimistic note. Although lead-times for some equipment remain elevated, the supply chain crunch in 2021/22 is behind us. Energy storage systems continue to get cheaper, and better. Capital markets have embraced energy storage

US ENERGY STORAGE SYSTEM COSTS ($/kWh)




**Wall Street Wants In on America's Battery Storage Boom**

**Storage developer esVolta secures $185M credit facility**

**Sean Wolfe**
*4.9.2024*

Jul 30, 2024

**esVolta Secures $258 Million Credit Facilities for ERCOT Storage Portfolio**

**esVolta secures $110m tax equity investment for 300MWh energy storage facility**

The Hummingbird project will offer energy services to the CAISO market.

November 13, 2024

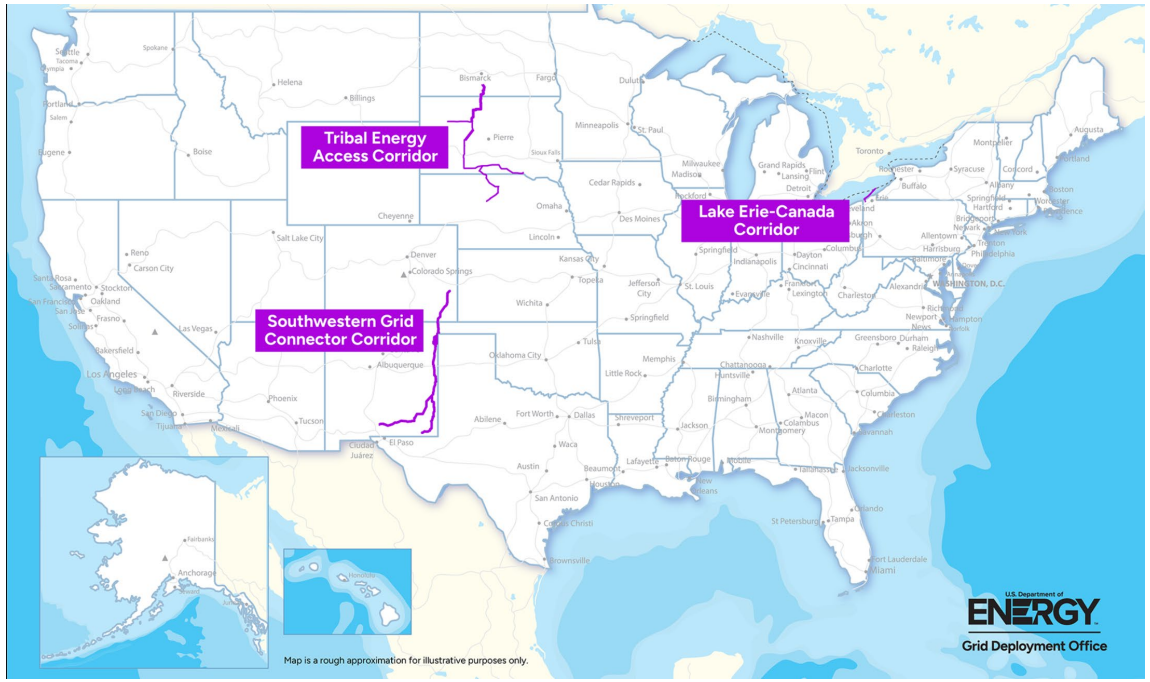
 Source: BloombergNEF. Note: Energy storage system costs for large AC energy storage system at beginning of life, on a useable basis

# Turning the corner on T&D

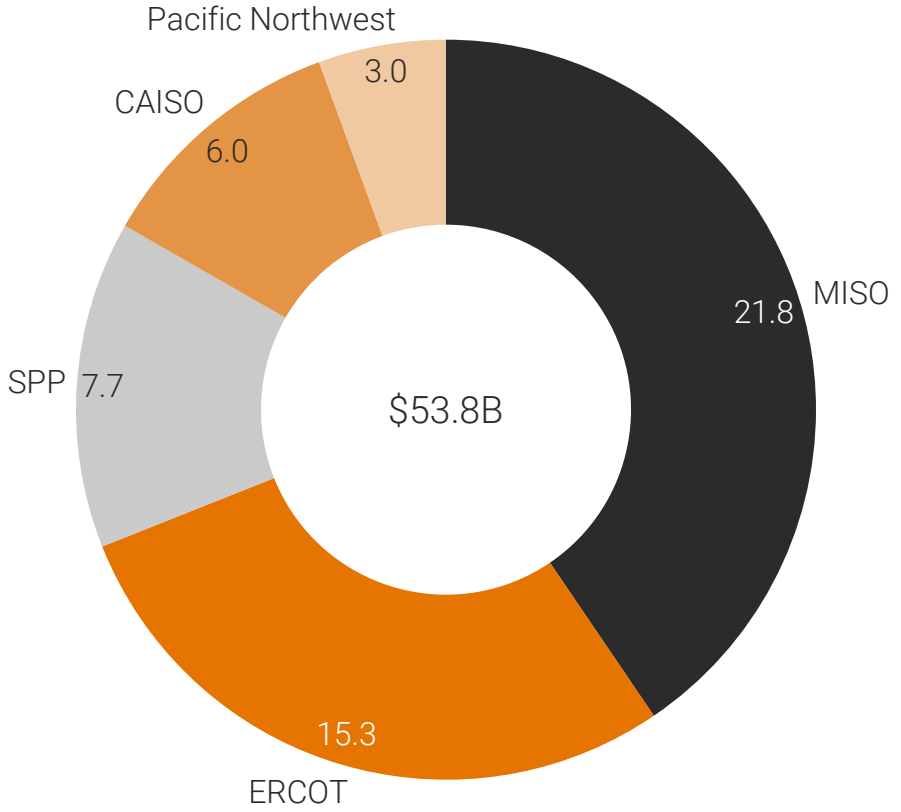
# What happened? 2024 was a breakthrough year in terms of both interconnection reform and transmission build out, even if it will take time for it to bear fruit

The implementation or in many cases in anticipation of FERC Order 2023 reforms helped trim >200GW of capacity from the IQ in 2024, leaving behind a large but healthier queue. Less can sometimes be more. FERC Order 1920 was also a step change in terms of both process and substance for transmission reform. Over $50B in new transmission expansion was approved in 2024.

POTENTIAL NATIONAL INTEREST ELECTRIC TRANSMISSION CORRIDORS




INVESTMENT IN TRANSMISSION CAPACITY APPROVED IN 2024[1]

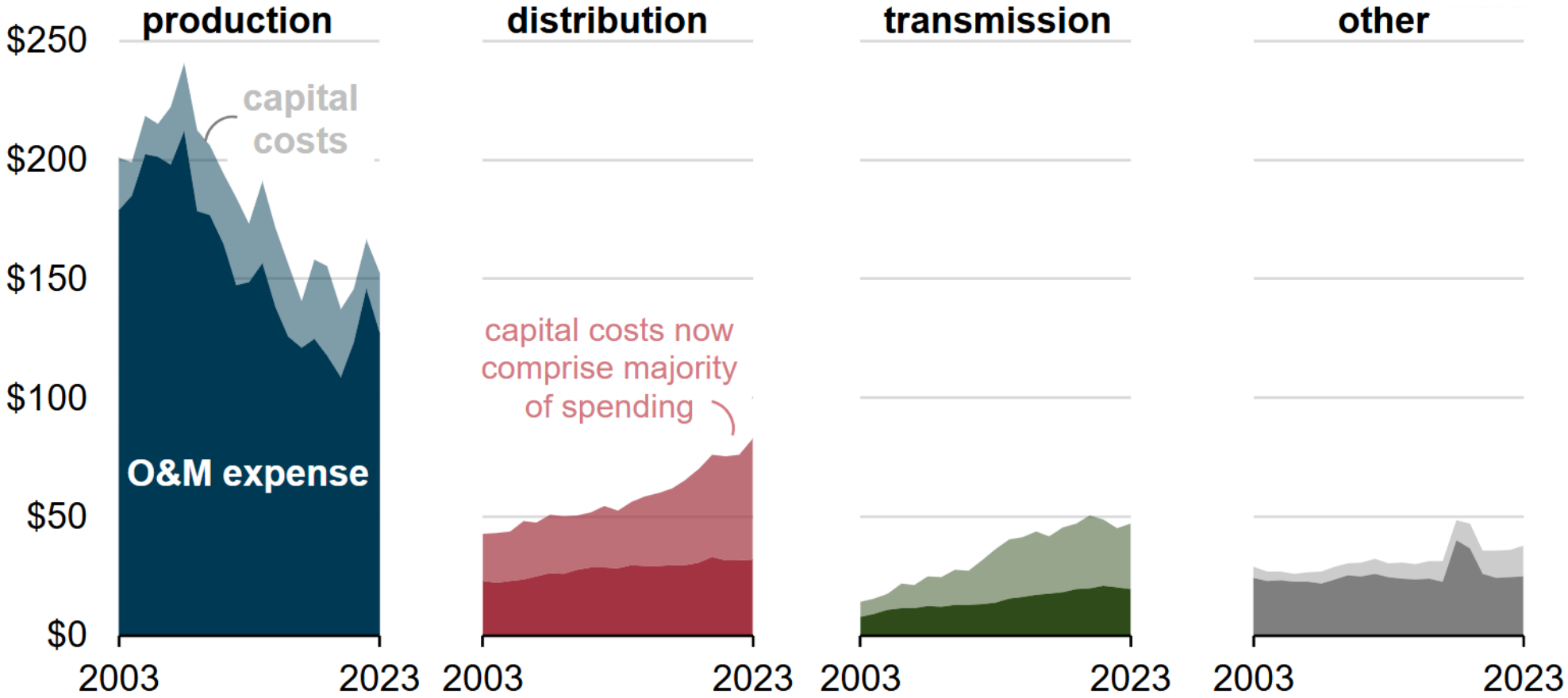





[2] Grid Strategies, ERCOT, the US Department of Energy

# A cautionary tale. Spending on electricity transmission systems nearly tripled from 2003 to 2023. Renewed investment in transmission expansion could further drive up costs to customers.

ANNUAL US UTILITY SPENDING ON ELECTRICITY INFRASTRUCTURE FROM 2003 TO 23 ($B)[1]

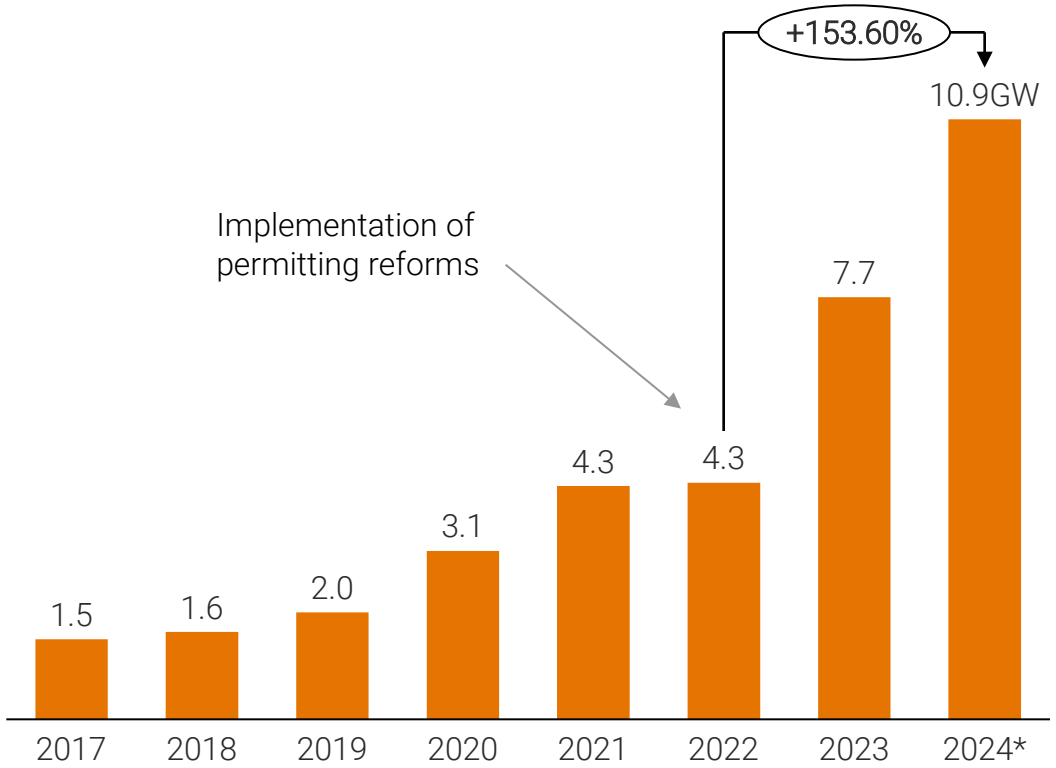




[1] U.S. Energy Information Administration and Federal Energy Regulatory Commission (FERC) Financial Reports, as accessed by Ventyx Velocity Suite

# An optimistic note. Discussions around T&D tend to be downbeat, with a focus on the slow pace of interconnection and permitting reforms, and network expansion. It's not all doom and gloom. The US still managed to add record amounts of clean power in 2024, there is plenty of pent-up supply, distributed solutions such as Community Solar face fewer challenges and examples from Europe show how quickly things can change when reforms work. Gradually and then suddenly.

GERMAN ONSHORE WIND CAPACITY PERMITTED BY YEAR AWARDED[1]




On a related topic: industrial customers in Germany can receive up to 80% to 90% reduction on their grid fees through the atypical grid use program, which applies when companies shift their peak demand away from high-load periods.

Creativity, such as via flexible demand or supply connections, demand response, and VPPs has the potential to unlock grid capacity quickly, cheaply and at a massive scale.

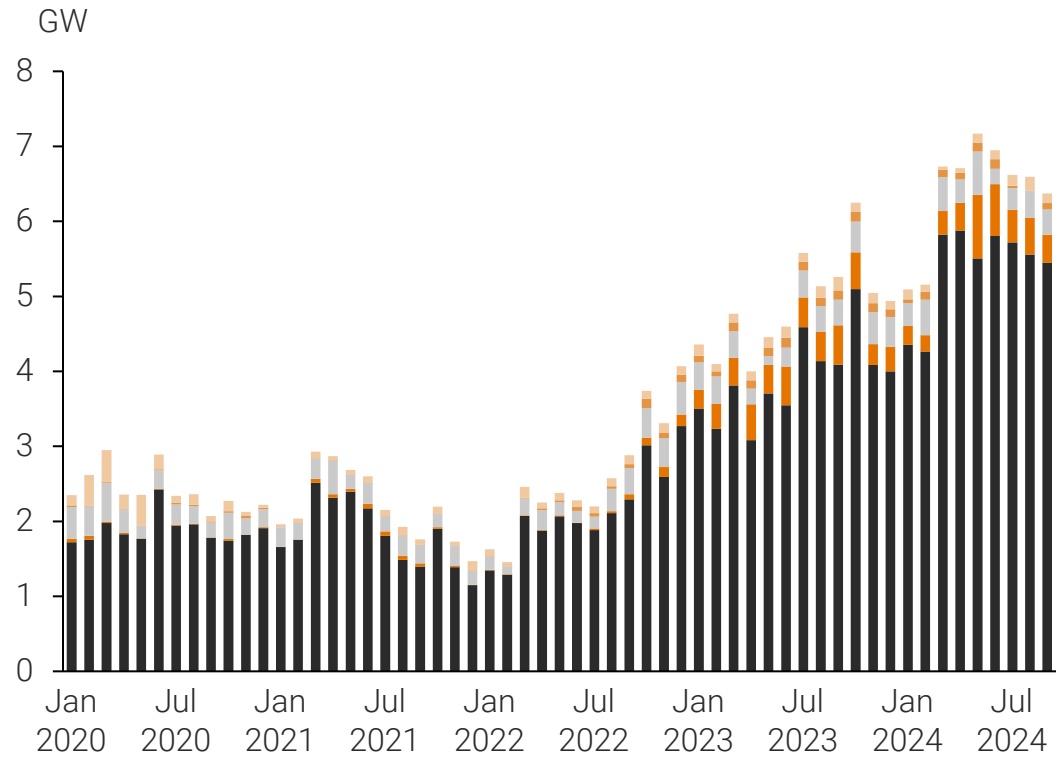
Today's bottlenecks are real, and painful. But solvable.


[1] BloombergNEF, FA Wind (German Onshore Wind Energy Agency). Note: * 2024 data covers January through October

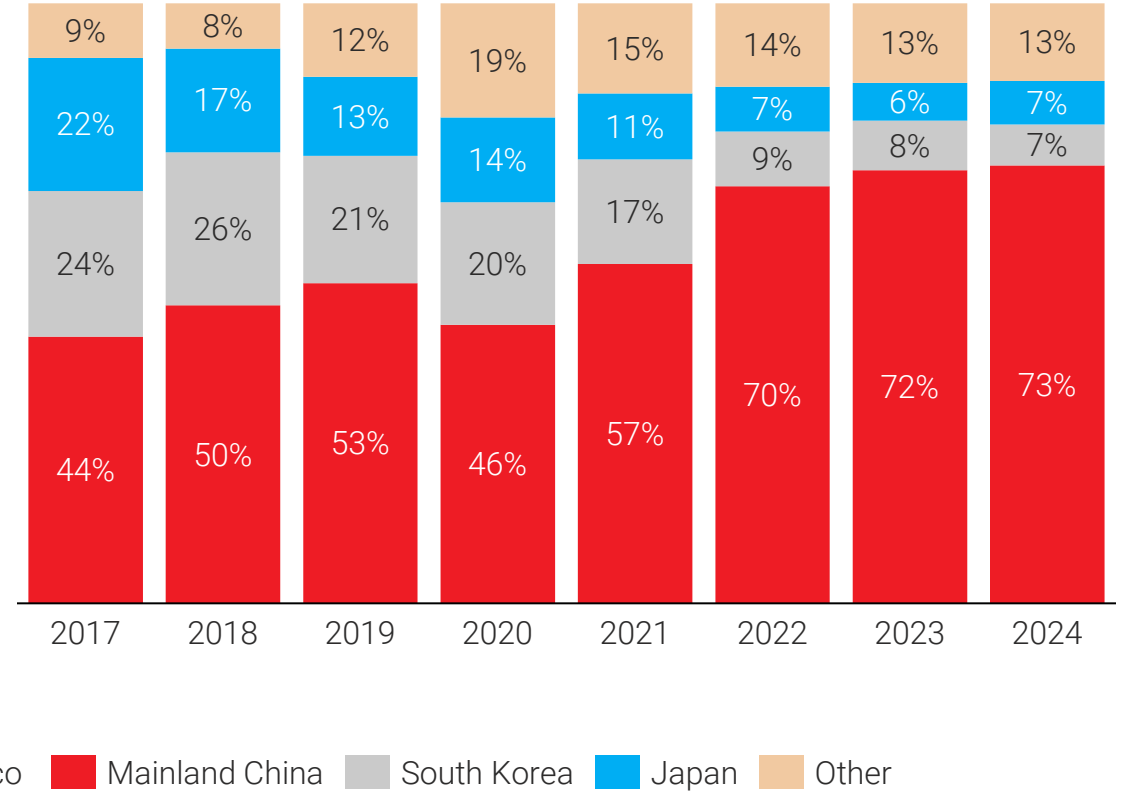
# Supply chains

# What happened? Solar imports to the US increased to record levels in 2024, as did the share of US lithium-ion battery imports from China

US IMPORTS OF PV MODULES AND CELLS[1]



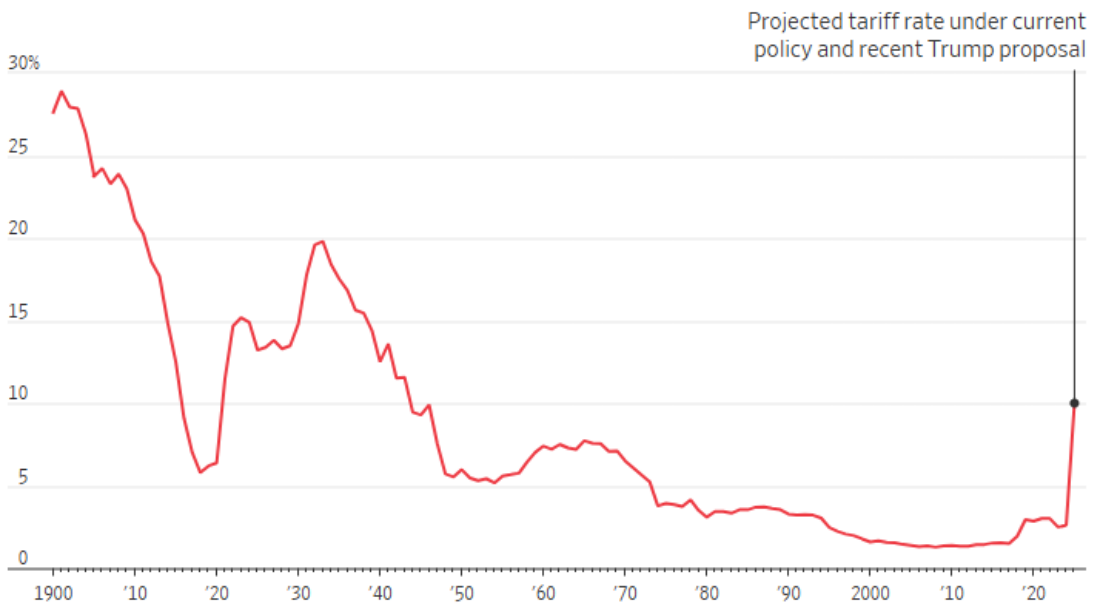

SHARE BY VALUE OF US IMPORTS OF LITHIUM-ION BATTERIES



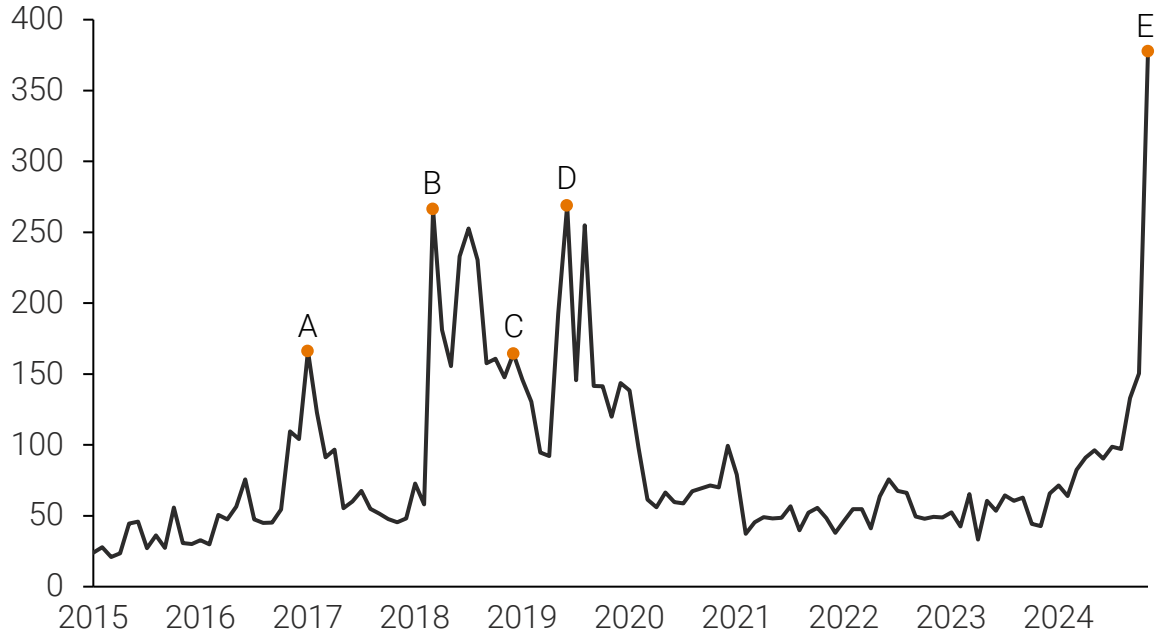

 [1] BloombergNEF Solar Supply Chain Index. [2] BloombergNEF Clean Energy Trade Dashboard. 2024 data through April.

# A note of caution. The sweeping imposition of tariffs on import goods would push up the effective tariff rate to the highest level since the 1940s, pushing up inflation. Quite the risk for the incoming administration.

US AVERAGE EFFECTIVE TARIFF RATE[1]



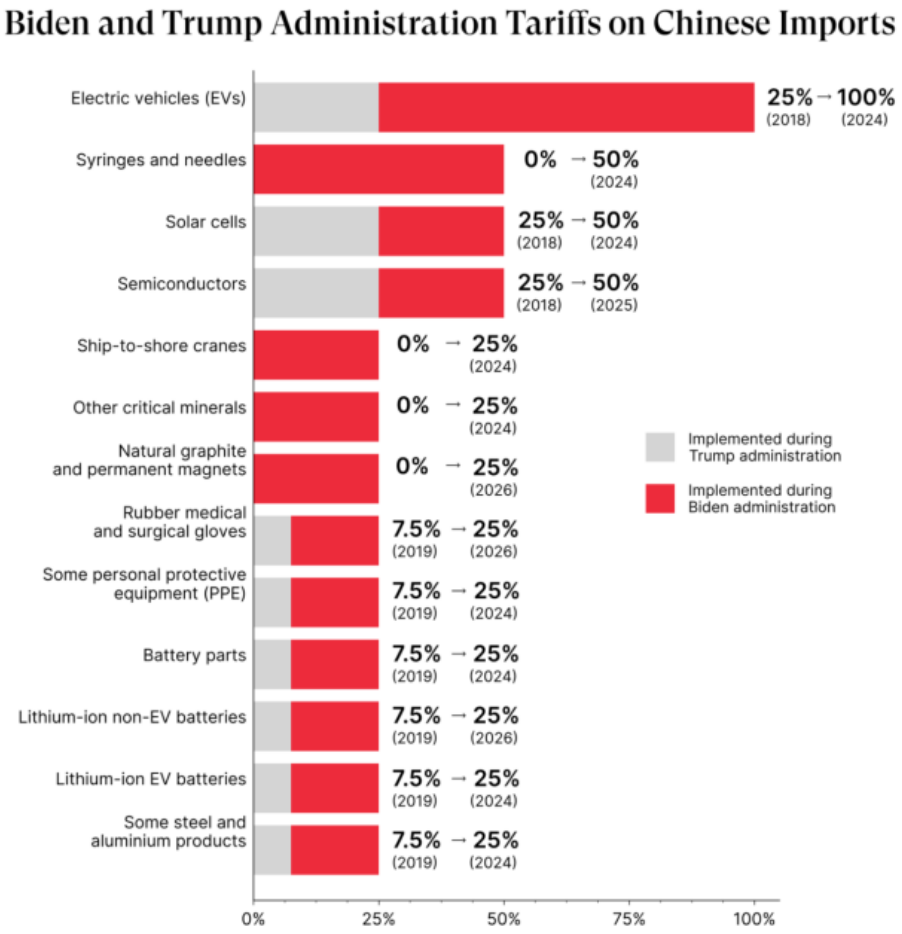

TPU INDEX: MONTHLY AVERAGE FREQUENCY OF ARTICLES DISCUSSING TRADE POLICY UNCERTAINTY[2]




| | |
|---|---|
| A: Trump takes office (the first time) | D: Stock markets fall |
| B: Announced tariffs on aluminum and steel | E: New tariff threats on Mexico |
| C: Tariffs on Chinese goods go into effect | F: Trump wins 2024 election |

[1] WSJ. The Budget Lab at Yale, Historical Statistic of the United States Ea424-434, Monthly Treasury Statement, Bureau of Economic Analysis. Note: Trump proposal assumes additional 25pp tariff on Canada and Mexico goods imports and 10pp tariff on Chinese goods imports. [2] Trade Policy Uncertainty Index. Note: The TPU index is based on automated text searches of the electronic archives of seven newspapers: Boston Globe, Chicago Tribune, Guardian, Los Angeles Times, New York Times, Wall Street Journal, and Washington Post. The measure is calculated by counting the monthly frequency of articles discussing trade policy uncertainty (as a share of the total number of news articles) for each newspaper. The index is then normalized to a value of 100 for a one percent article share. The TPU Index starts in 1960.

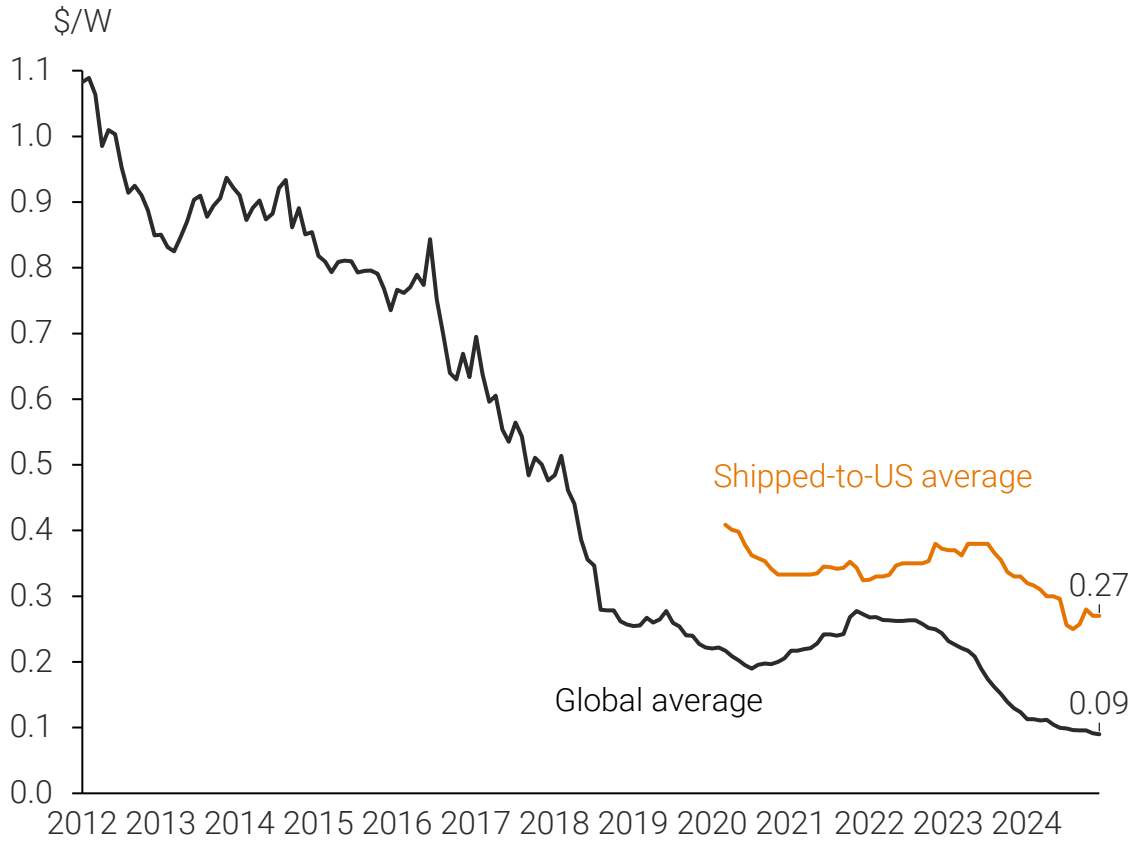
# More targeted tariffs on clean energy sectors represent a continuation but escalation of an already imposing smorgasbord of tariffs on solar and batteries. As of December 2024, solar tariffs include anti-dumping and countervailing duties, section 201, section 301, Uyghur Forced Labor Prevention Act and anti-circumvention tariffs.



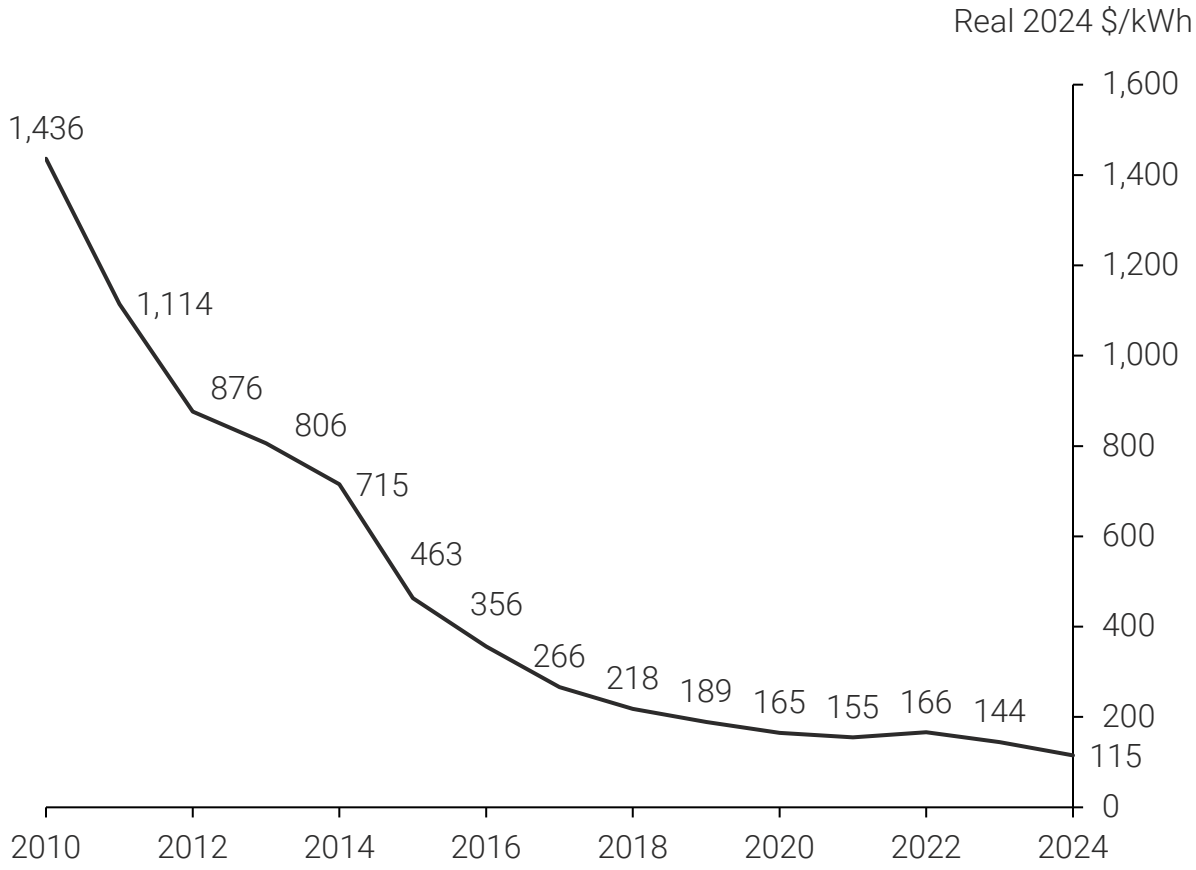

 Source: Visual Capitalist, Grayson Hoteling

# An optimistic note. Even as tariffs go up, the price of core energy transition technologies is falling. In many cases this keeps the cost of imports, even in high tariff scenarios, competitive. Labor however remains an issue: help wanted.

AVERAGE MONTHLY MONOCRYSTALLINE SILICON MODULE (C-SI) PRICES[1]




LITHIUM-ION BATTERY PRICE SURVEY[2]

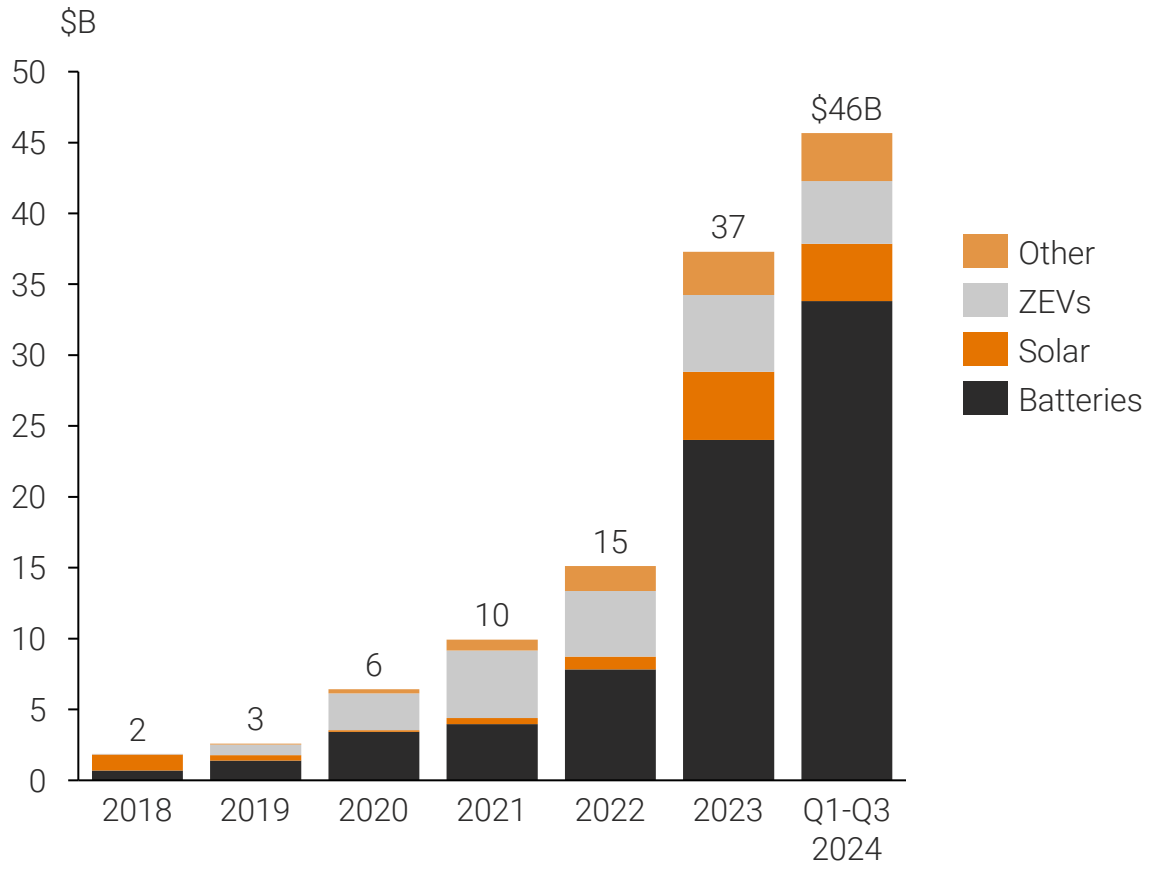




[1] BloombergNEF Solar Spot Price Index, PV InfoLink. [2] BloombergNEF Battery Price Survey. Note: Volume weighted average price across sectors

# Our role. The response to tariffs is both a risk management exercise for Generate and its partners, and an investment opportunity: The US has rediscovered its manufacturing mojo and this needs a lot of capital.

ACTUAL US CLEAN ENERGY MANUFACTURING INVESTMENT[1]




HOW TO PREPARE FOR TARIFFS

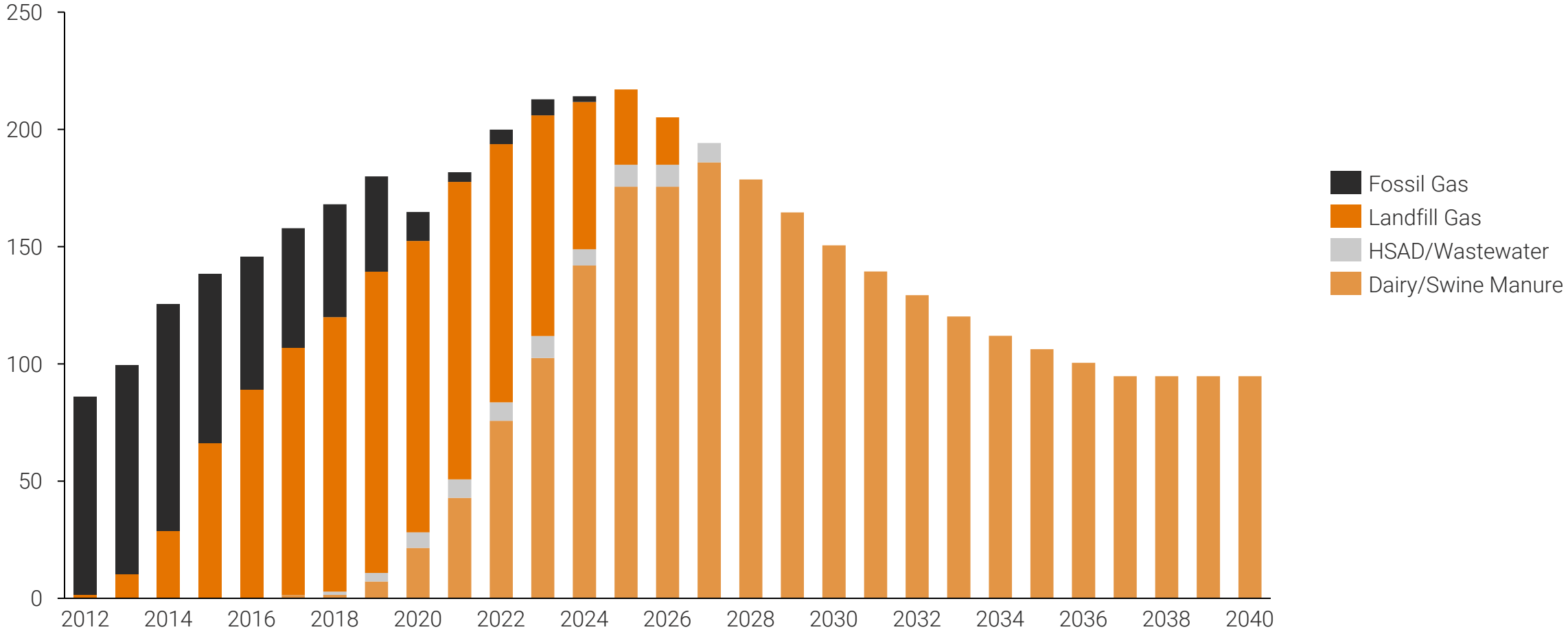
- Multiple procurement strategies exist, and leading companies are well placed to balance available pricing and technology performance against policy risks across a large supplier pool.
- Partial risk mitigation may include avoiding UFLPA target suppliers, sourcing non-Chinese/domestic cell supply, ensuring use of non-Chinese interconnection/control technology, and tariff cost sharing.
- Other options include bringing forward procurement of certain items to either safe harbor or to mitigate against potential cost increases


[1] The Clean Energy Monitor (a joint effort of Rhodium Group and MIT's CEEPR). Note: ZEVs = Zero Emission Vehicles.

# Waste

# What happened? Dairy RNG continued to squeeze out landfill gas in 2024, which had in turn displaced fossil. CNG vehicle dispensing capacity across state LCFS programs is full, leading to higher commissions for those seeking to enter the market, and a push to lock in new sources of demand.

TRANSPORTATION CNG BY FEEDSTOCK (MILLION GDE[1])

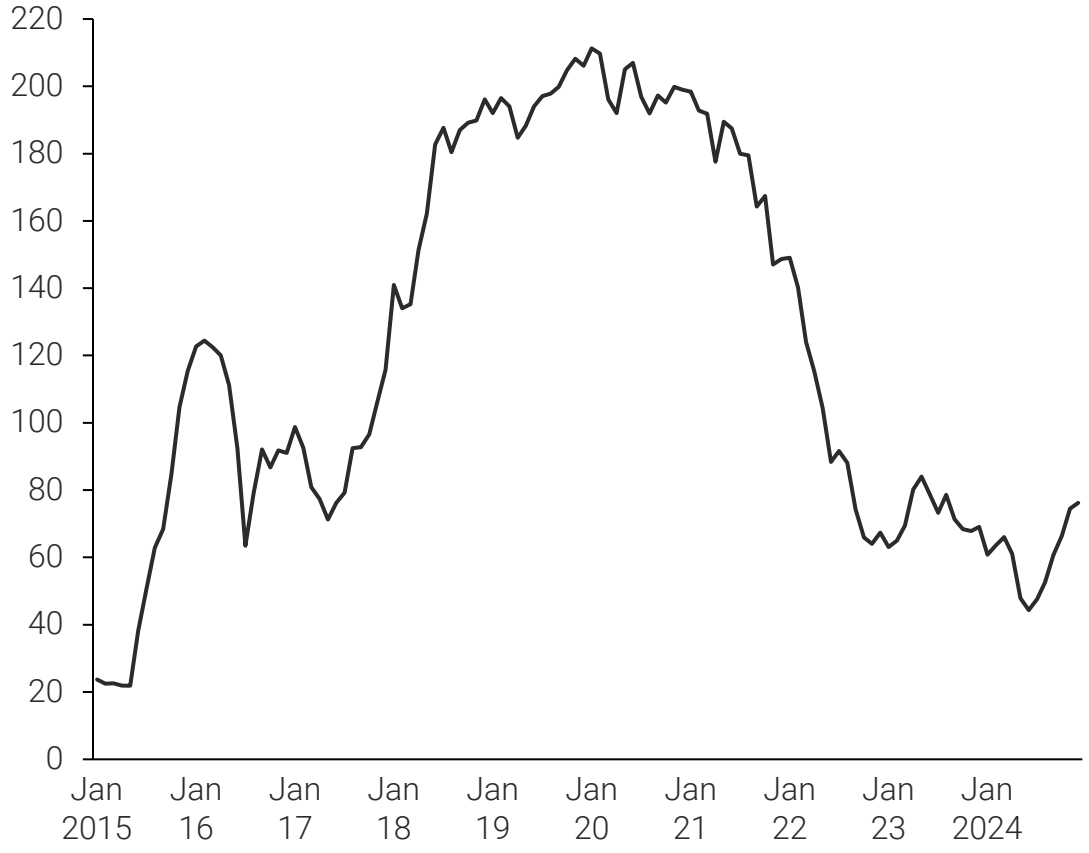




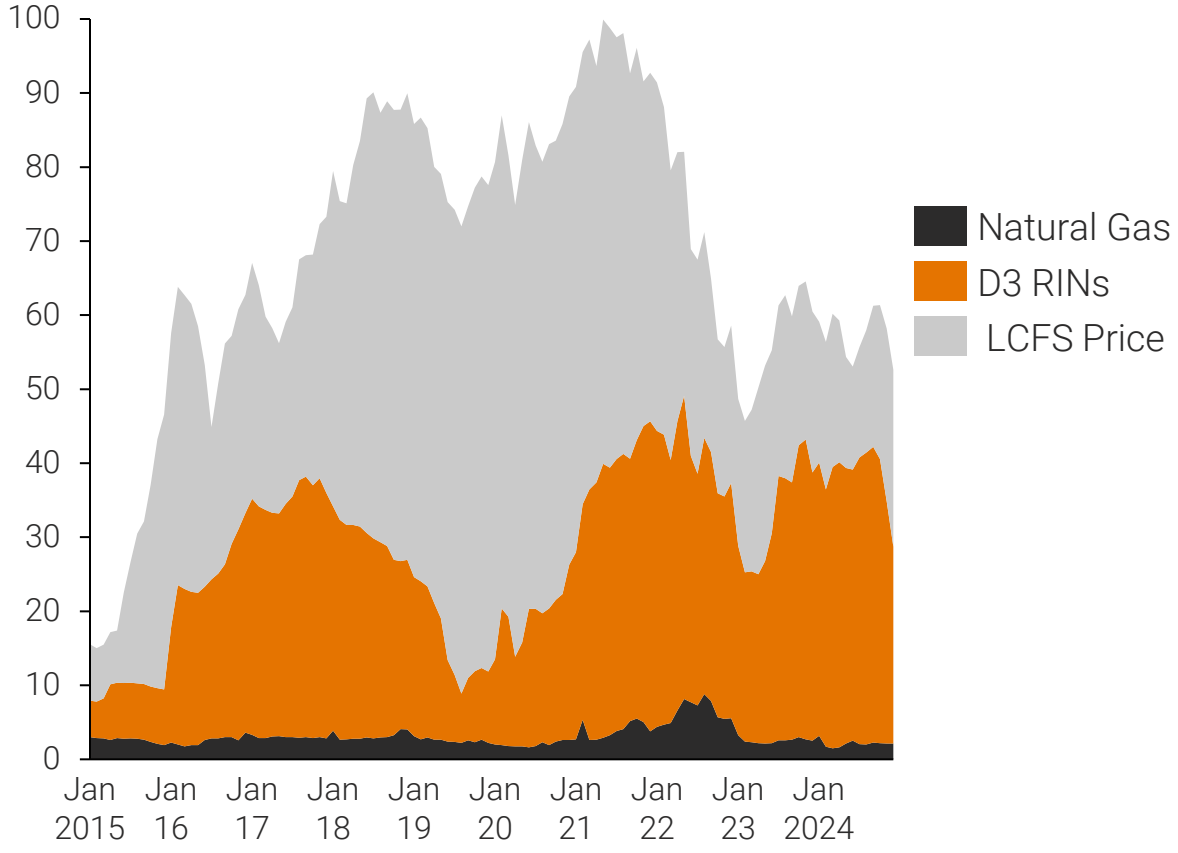
[1] California Air Resources Board, Generate internal analysis. Note: GDE = Gasoline Diesel Equivalent. HSAD = High-Solids Anaerobic Digestion

# An optimistic note. CARB's final adopted rule in November should boost and sustain LCFS pricing from recent lows, and green shoots are emerging for long-term RNG contracts that recognize CI value from new sectors.

LCFS MONTHLY CREDIT PRICE ($/CREDIT)[1]




RNG VALUE COMPOSITION ($/MMBtu)

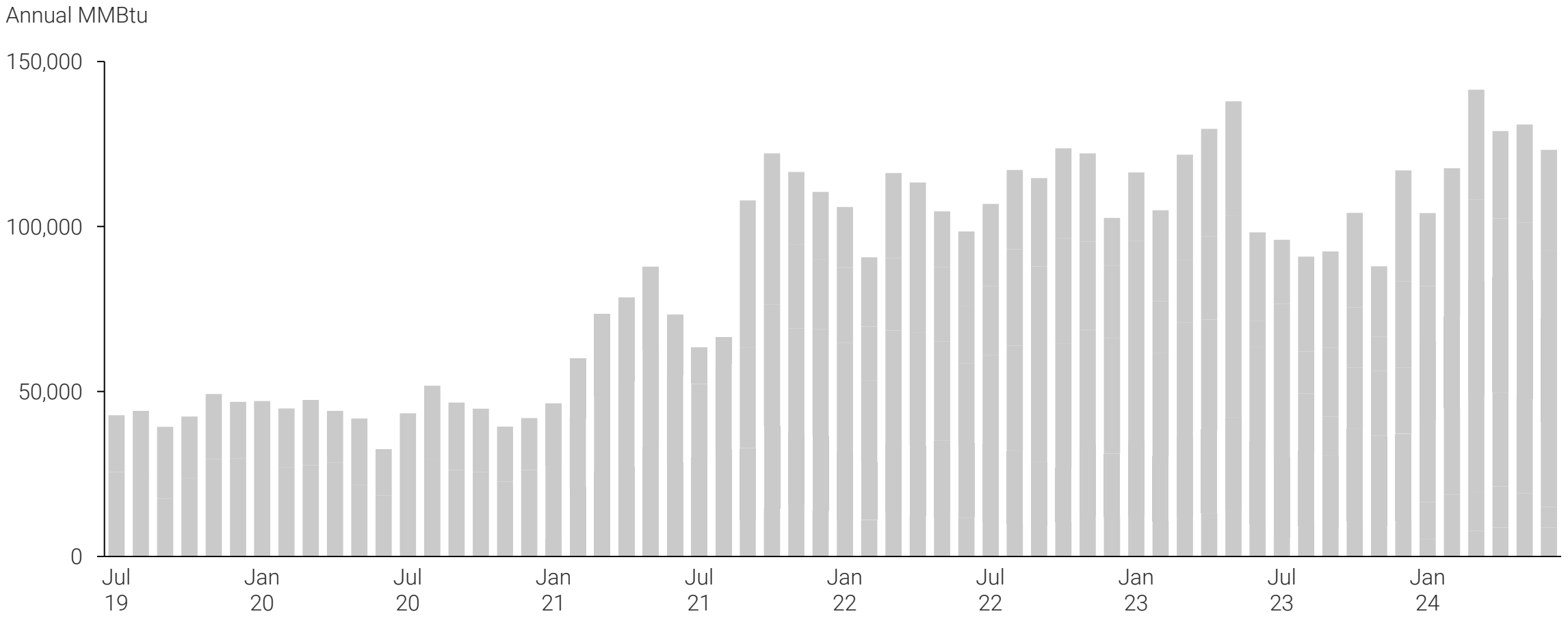




[1] CARB, Argus Media

# Our role. Across Generate, we took a cautious approach to any capacity expansion in 2024 and focused on nurturing green shoots for long-term contracting of RNG in non-transport applications that values carbon intensity

ANNUAL MMBTU PRODUCTION AT UNIQUE AMP AMERICAS FACILITIES[1]

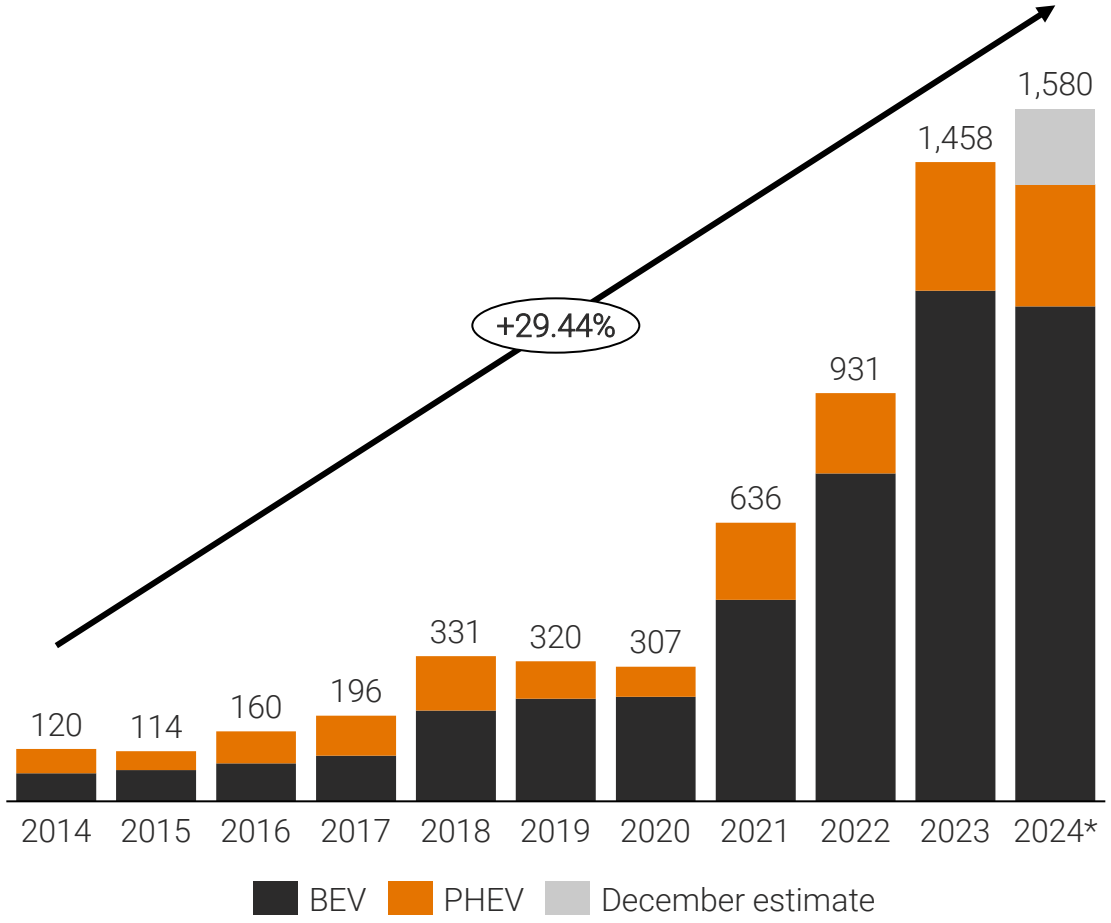



 [1] Generate Capital. Amp Americas. [2] Note: GDE = Gasoline Diesel Equivalent

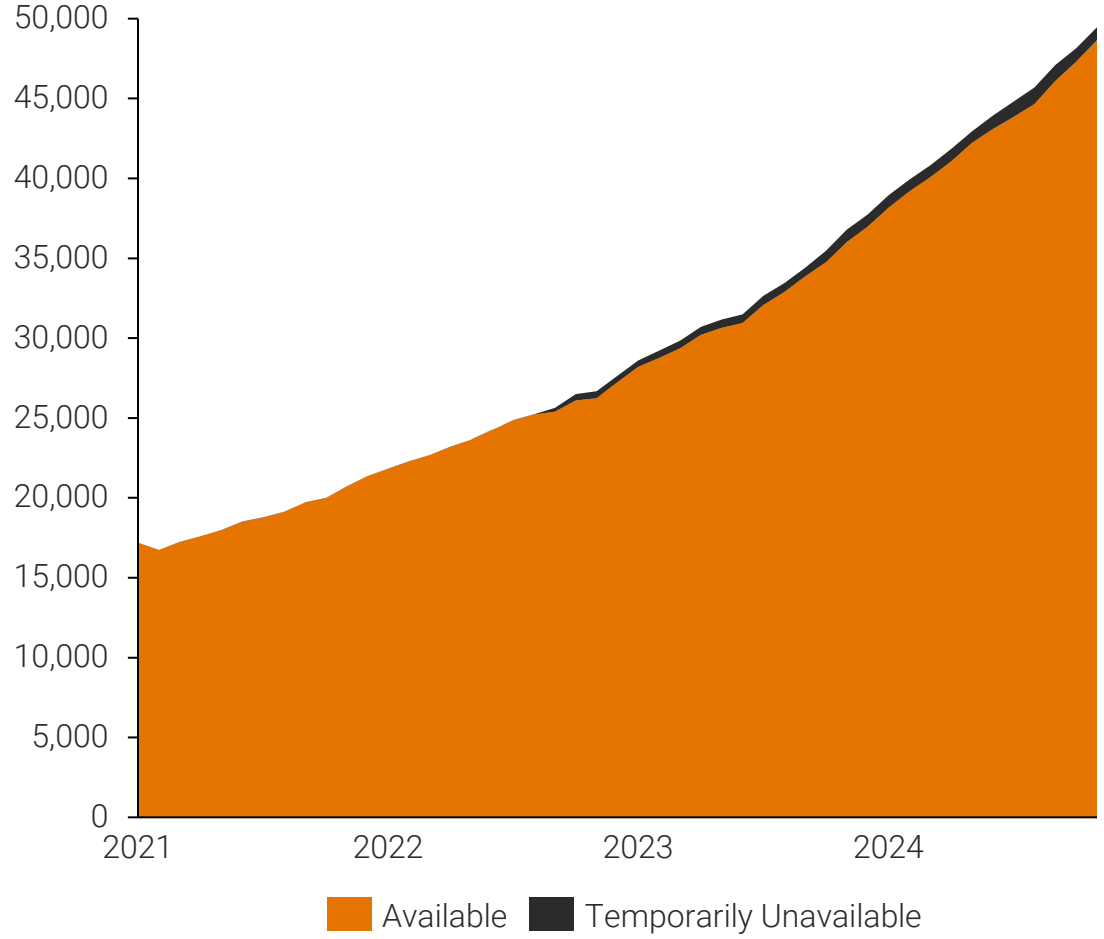
# Mobility

# What happened? Plug-in sales were ~12% of all light duty vehicle sales as of Q3, with EV sales up 17% YoY. Less than giddy expectations, but still remarkable progress. Charging infrastructure availability accelerated.

## US PLUG-IN ELECTRIC VEHICLE SALES (THOUSANDS)[1]




## US PUBLIC EV DC FAST CHARGING POINTS BY MONTH[2]






[1] Argonne National Laboratory. Note: Estimate based on historical share of December sales. December has made up 11% of total plug-in sales over the last three years. [2] Joint Office of Energy and Transportation

# A cautionary tale. Removal of the electric vehicle tax credit would further hinder US automotive companies efforts to profitably manufacture EVs

ENERGYWIRE

## Chris Wright and Sean Duffy hold the keys to Trump's EV plans. How far will they go?

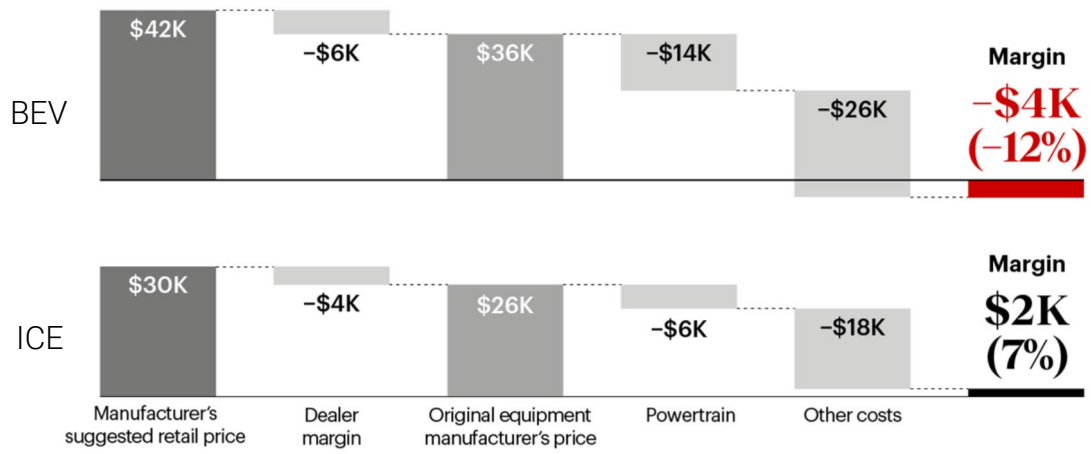
By David Ferris, Mike Lee | 12/02/2024 06:49 AM EST

## Trump's EV Plan Is to Pick Losers

Undercutting electric vehicle demand while supporting the manufacture of batteries and other components sets up the auto industry for failure.

December 18, 2024 at 8:43 AM PST

ESTIMATED VEHICLE PRICE AND ASSOCIATED COSTS IN THE US[1]



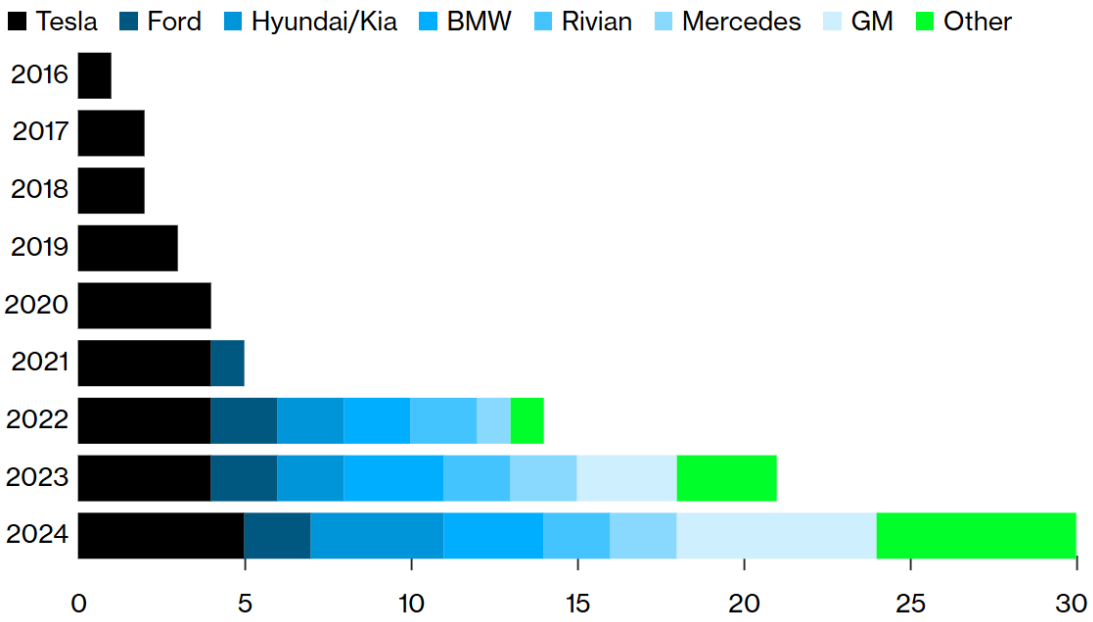


[1] Bain & Company

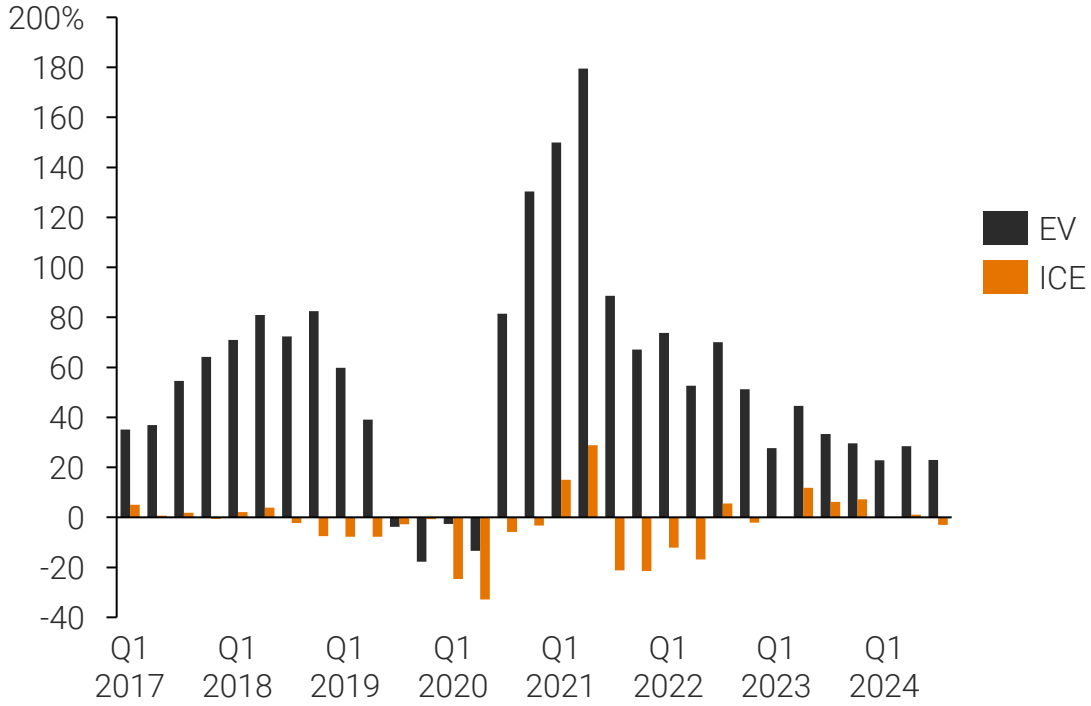
# An optimistic note. The automotive industry has hit peak auto and EVs not ICE are the source of growth for companies due to regulatory pressure and massive technological progress. It's hard to pick winners, but much easier to pick losers.

"We are already starting to see the old order crumble."[1]

PERFORMANCE: UNIQUE US EV MODELS OFFERING 300+ MILES PER CHARGE[2]




PASSENGER VEHICLES SALES YEAR-ON-YEAR CHANGE[3]

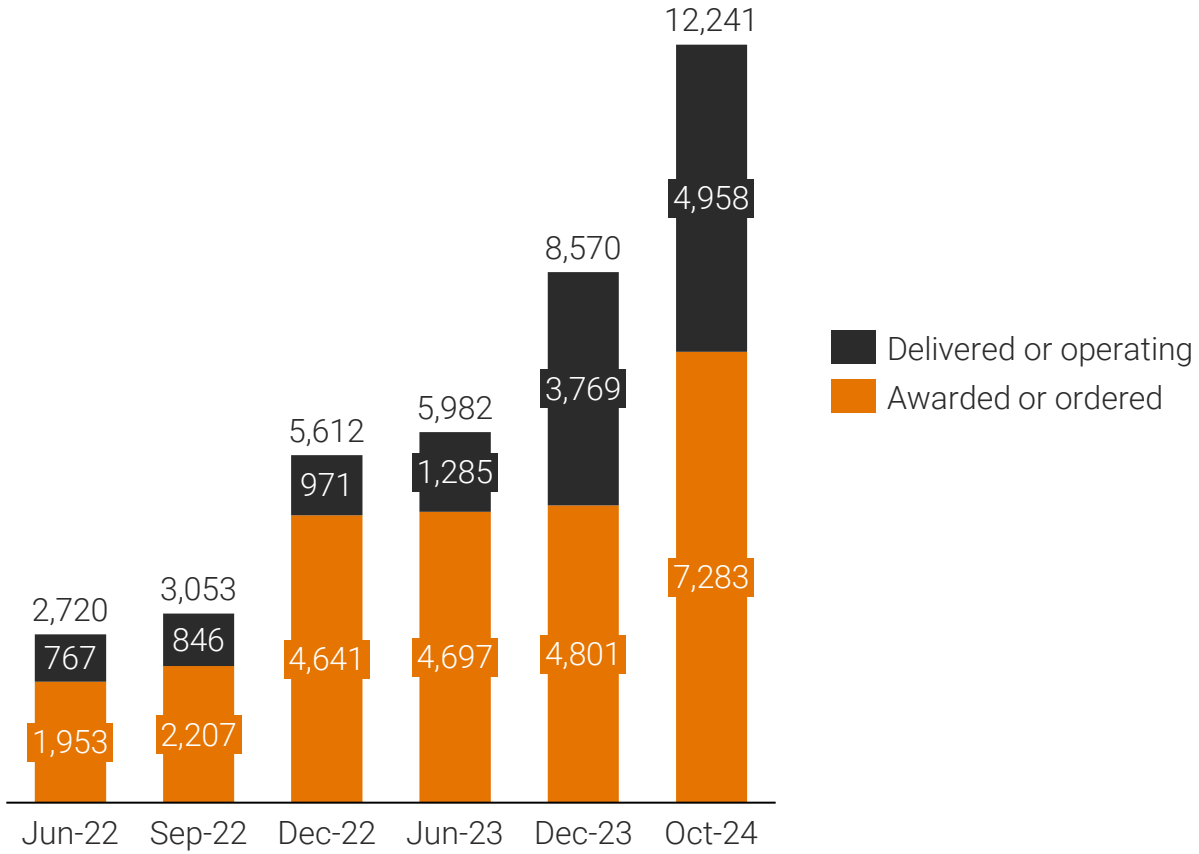



## Long-Range EVs Now Cost Less Than the Average New Car in the US

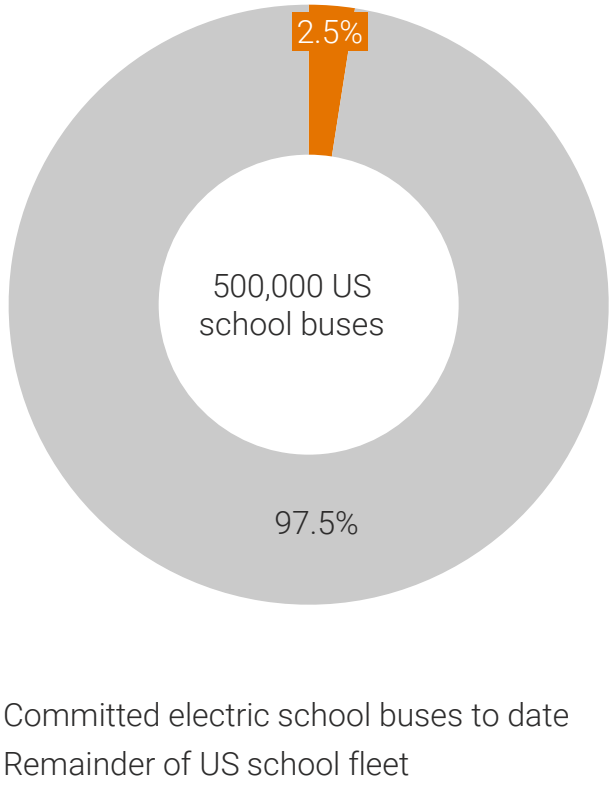
[1] Source: SAE Detroit Section "The US Automotive Industry at Risk", October 2024. [2] Bloomberg, US EPA, company website. Note: At least 20 additional models have been announced to start later 2024. Excludes model years with limited availability. Other: VW, Lucid, Polestar, Fisker, Nissan, Vinfast. [3] BloombergNEF Q4 Electric Vehicle Market Outlook

# Our role. Despite a rapid increase in committed electric school buses, the US total to date represents only 2.5% of the nationwide decarbonization opportunity. Generate's JV with Blue Bird is committed to expanding its share, improving air quality, reducing noise pollution, which results in lower GHGs and a more resilient and affordable system.

## US NEW COMMITTED ELECTRIC SCHOOL BUSES[3]




## NEW COMMITTED ELECTRIC SCHOOL BUSES[3]





*Source: The Electric School Bus Initiative (WRI). Note: As of October 2024*

GENERATE

LET’S REBUILD THE WORLD TOGETHER

Logan Goldie-Scot
Head of Research
logan.goldiescot@generatecapital.com

generatecapital.com