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Retail Power Shock

July 2024

Executive Summary

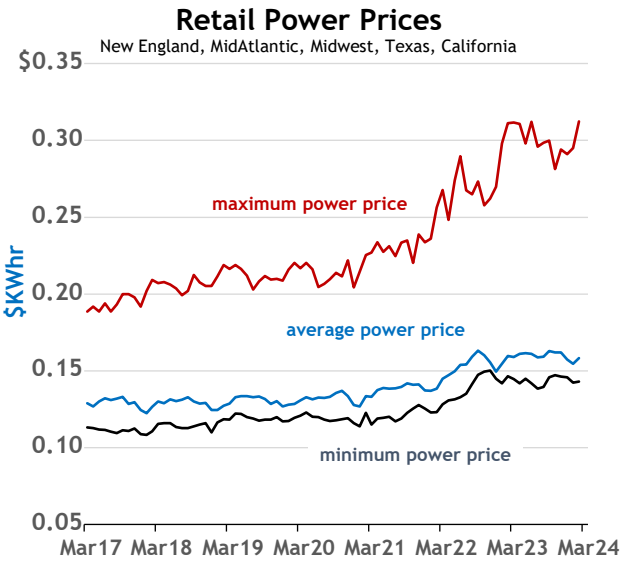
Retail electricity prices have climbed steadily since 2002 with a dramatic surge between 2021 and 2023. The average U.S. residential rate jumped from 13.75 cents per kilowatt-hour (kWh) to 15.98 cents/kWh in just two years. This report examines the key factors driving this trend, which comes from an evolving regulatory landscape with shifting supply/demand dynamics.

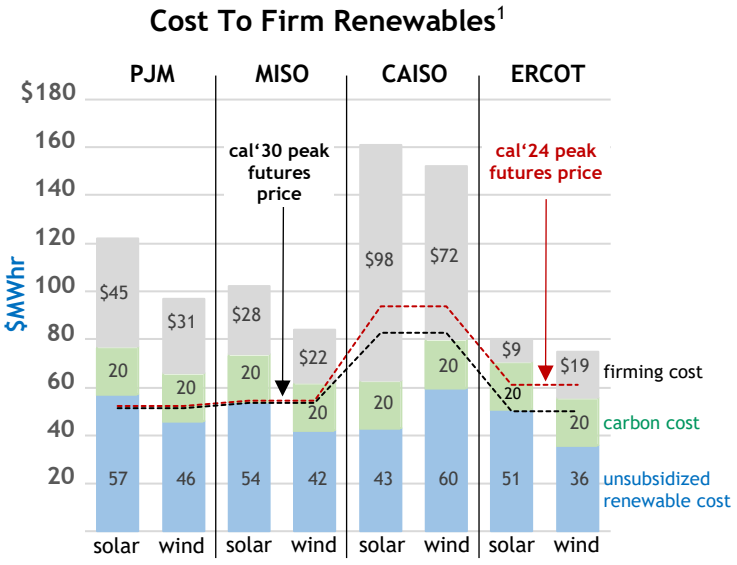
While historical data shows an average annual increase of 3%, recent developments suggest a potential for significantly greater price hikes in the future for two reasons.

- **Retail Price Trends Continue to Move Higher**: Historical residential power prices have trended up across all US power sectors and price forecasts underestimate future price increases.

- **US Residential Rates Do Not Reflect the Full Cost to Provide Power**: U.S. residential power rates do not reflect current forward prices or the anticipated cost pass-through associated with the capital cost of new renewable generation, transmission lines, and grid infrastructure, and the expense of carbon offsets required for a zero-emission grid[1].

Dramatically higher retail power prices are inevitable as power markets begin to reflect capital costs of new investments, increasing operating expenses, and a growing shortfall in supply to meet demand on the grid. The results for the retail customer could be shocking.





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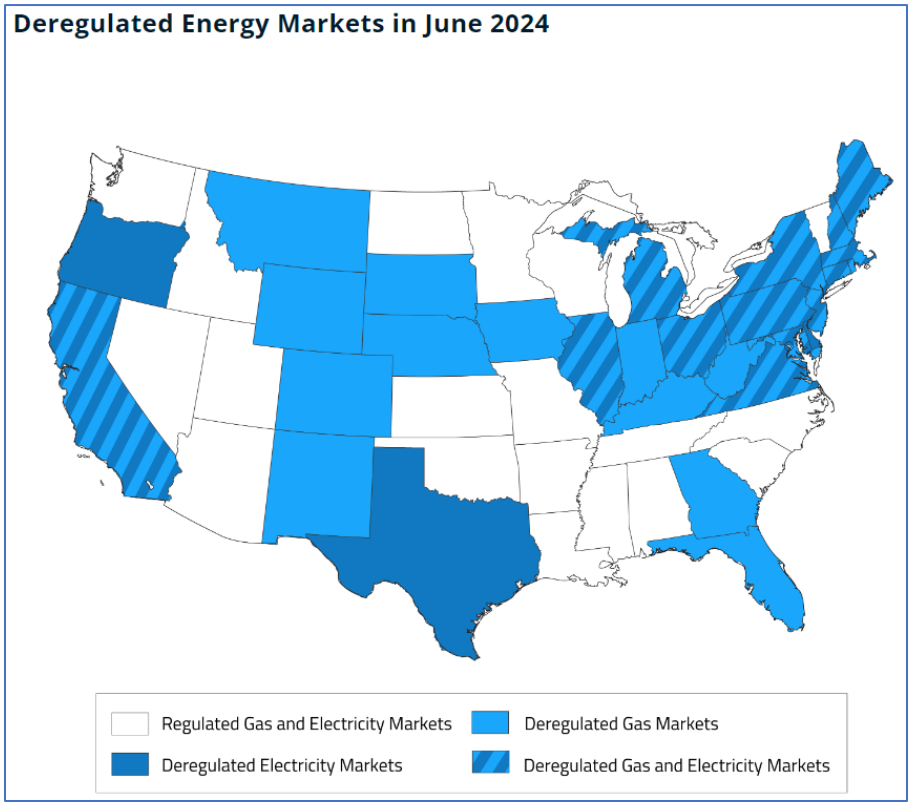
US Retail Power Primer

The way electricity reaches homes in the US varies depending on location. Unlike some countries with a centralized system, the US has a decentralized approach to retail electricity markets. In some states, a traditional utility structure exists, whereby the local utility generates and sells electricity to captive customers, offering limited choices.

However, many states have adopted a more competitive model called Retail Electricity Choice. This allows customers to select their electricity supplier from a pool of competing retailers. These retailers purchase electricity in bulk from wholesale markets, often managed by independent system operators (ISOs) or regional transmission organizations (RTOs). These markets determine the wholesale price of electricity based on factors like supply, demand and generator marginal costs.

Retailers then add their own markup and offer various plans to customers. These plans may include fixed rates, renewable energy sources, or even time-of-day pricing options. Depending on the state, residents may be served by the local utility or have the power to choose a plan that best suits their needs and budgets.



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US Wholesale Power Primer

Unlike retail markets where users can choose a provider, wholesale power markets determine the bulk price of electricity for utilities and large consumers. These markets operate on a supply-and-demand basis. Generators submit bids specifying the price at which they are willing to sell electricity. Bids factor in fuel costs, production capacity, expected weather conditions and such extraneous factors as transmission constraints, emissions allowances and other variables that affect wholesale power prices.

The ISO then determines the clearing price, the lowest price at which enough electricity is offered to meet anticipated demand. Generators whose bids fall below this price sell their electricity, while those with higher bids will not be selected and under normal conditions will not run or generate electricity for that period. This dynamic pricing system aimed to ensure a reliable electricity supply at the most efficient level.

Wholesale electricity generators operate in a volatile market. While they can influence prices through their bids in real-time, future fuel costs and demand remain uncertain. This is where forward markets come in.

Forward markets allow generators to lock in prices for electricity delivery at a future date. They essentially eneter contracts to sell electricity at a pre-determined price months or even years in advance. This hedging strategy protects generators from unexpected price drops, ensuring a more predicatable revenue stream. However, it also comes with the risk of missing out on windfall profits if real-time prices rise above the contracted price.

Example of Forward/Futures Market Quotes and Trading

Strip	...	+/-	Sell	B Qty	Bid	Offer	O Qty	Buy	Last	Cha...	Settl...	OI	OI Chan...	High	Low	WAP	Volume	Block Vol	Total Vol...
Q4 25		+		1	51.50	52.00	5		51.75	-0.90	52.65			52.15	51.75	52.04	17		17
Q4 26		+		1	54.75	56.35	5		54.75	-0.49	55.24			54.75	54.75	54.75	2		2
Cal 25		+		6	56.70	56.85	5		56.75	-1.34	58.09			58.40	56.65	57.52	345	405	750
Cal 26		+		5	61.10	61.25	5		61.25	-0.66	61.91			62.05	61.25	61.52	68	379	447
Cal 27		+		3	63.60	63.85	10		63.90	-0.34	64.24			64.75	63.70	64.03	20	75	95
Cal 28		+		2	65.40	65.85	5		65.50	-0.73	66.23			65.50	65.50	65.50	25		25
Cal 29		+		2	67.65	68.10	5				68.84								
Cal 30		+		2	69.15	71.60	5				71.76								

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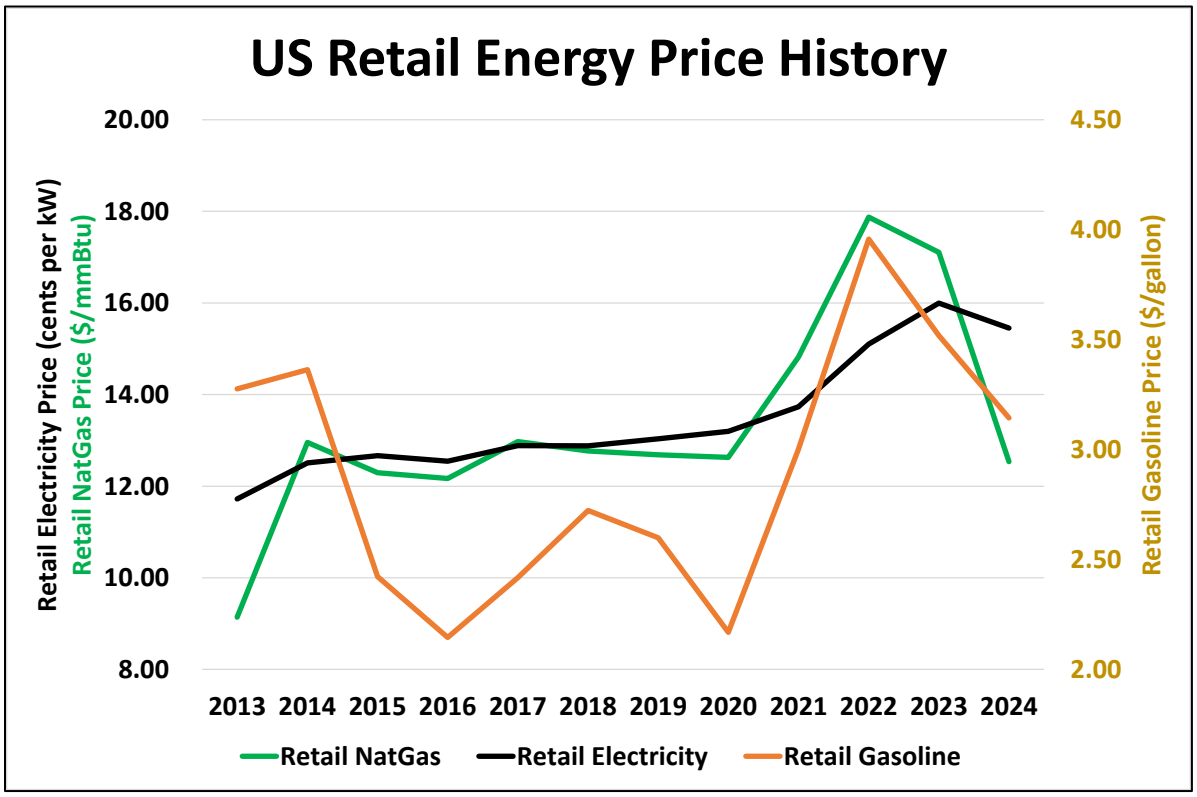
Historical Price Analysis

Unlike gasoline or natural gas, electricity prices are heavily influenced by instantaneous supply/demand balance. This is because electricity is difficult to store in large quantities, so power grids must constantly match supply with demand in real-time. During peak hours, when retail use is greatest, power prices are prone to spike as generation plants struggle to meet high demand (commonly referred to as "load"). During off-peak hours (evenings, early mornings and weekends), there is little incentive to lower prices because the excess electricity can't be readily stockpiled for later use.

In contrast, while natural gas prices also fluctuate based on factors like weather, they are also heavily influenced by storage capacity. Colder winters can increase demand for heating, driving prices up. Conversely, well-supplied storage facilities can help buffer price swings. Similarly, gasoline prices are influenced by crude oil costs, refinery capacity and taxes, leading to the up-and-down pump prices that most consumers see.



Historically observed retail electricity prices modestly increased until ~2020; thereafter, and coincident to the "COVID-19 Rebound", rates increased significantly. The bulk of such

increases have occurred since January 2021 and are evident across all US electricity markets in demonstrably similar magnitude.

RESIDENTIAL AVERAGES HAVE SIGNIFICANTLY INCREASED

Average Residential Price	Rate (Jan '24) (centsper kW)	3-Year Change Jan '21 to Jan '24	6-Year Change Jan '18 to Jan '24
New England	27.32	30.10%	35.31%
Middle Atlantic	19.61	26.03%	26.84%
East North Central	15.65	18.74%	23.42%
West North Central	11.73	10.56%	11.93%
South Atlantic	13.95	22.80%	22.37%
East South Central	12.83	16.74%	23.01%
West South Central	13.17	23.20%	29.50%
Mountain	13.33	17.24%	15.81%
Pacific Contiguous	21.11	28.48%	41.87%
Pacific Non Contiguous	34.01	28.68%	28.24%

Source: EIA, BNEF

Current residential electricity rate forecasts for the balance of 2024 and for 2025 are too low.

2024 retail prices are forecasted by the EIA to be down almost 1% from 2023. This is based on January ’24 and February ’24 being the mildest winter on record (due to an El Niño event), which significantly depressed power demand and, consequently, electricity prices. However, the balance of 2024 harbors a different story. As of May 1st, 2024, the US is forecasted to experience its hottest summer on record – a fact that is only now beginning to impact forward power prices.

Similar logic applies to retail power price forecasts for 2025. True fundamentals are not reflected in the 2.3% EIA forecasted growth rate, which not only understates current supply/demand dynamics, but also understates the average historically observed growth rate of 3%.

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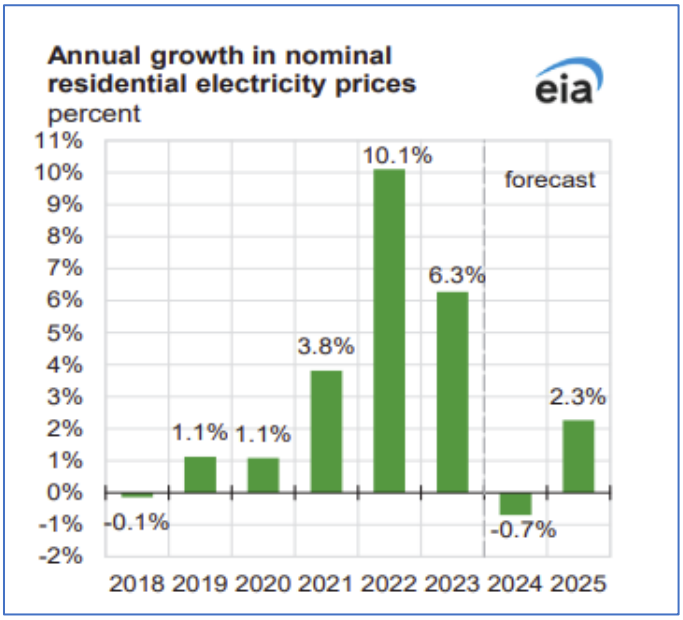

Expected Future Trajectory of Power Prices

Electricity trades like other commodities – it has a "spot", or cash market, as well as a robust futures market that enables buyers to lock in forward power prices months (and years) into the future.

Recently, forward power prices have risen significantly due to (1) understated demand, (2) overstated supply and (3) reliability concerns.

Understated demand can be primarily attributed to unforeseen growth in Artificial Intelligence, Data Centers, Electric Vehicles, and all relevant to the "Electrification of America"[2] (no natural gas stoves; no gas-powered lawn equipment, etc.[3]). Strong weather-normalized load growth has begun to manifest in forward wholesale power prices, without coincident impact to retail price projections.

In contrast, electricity supply is likely overstated, considering the tenuous economic future confronting fossil fuel plants. Increasingly stringent EPA rules and "zero emission" goals are challenging fossil generation economics, and are, therefore, likely to result in outsized fossil generation retirements[4]. Retiring fossil generation is expected to be replaced with renewable generation. However, renewable development has been delayed due to increasing costs (material, interest rates, and labor), permitting constraints, and grid interconnection difficulties[5].

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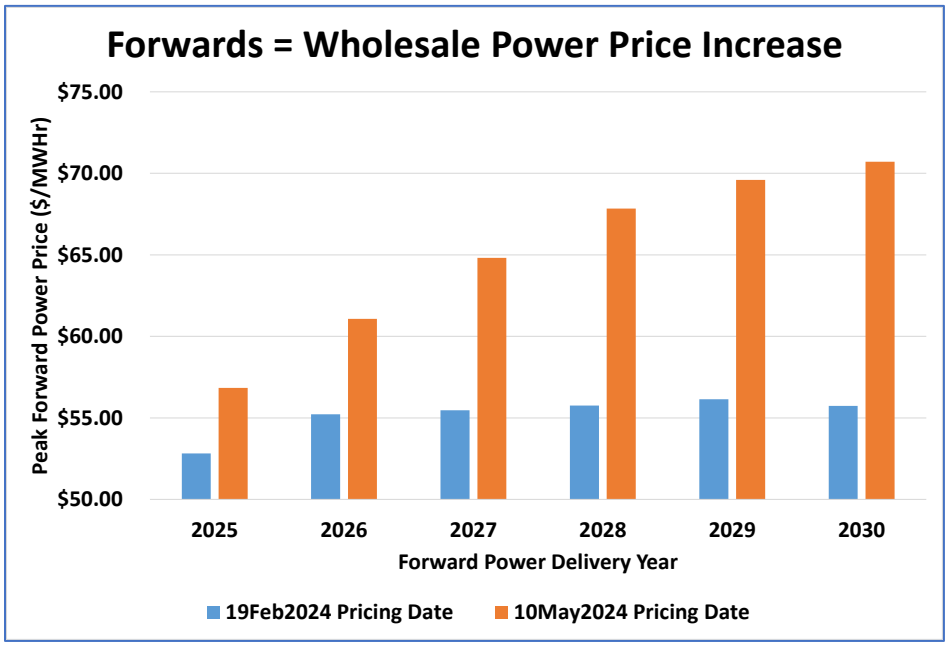
Forward electricity curves are beginning to reflect expected supply/demand imbalances. On a nationally-weighted basis, forward power prices have increased an average of 25% between mid-Feb '24 and early May '24. However, this is not yet reflected in retail prices.



Regulatory issues will also weigh on retail power prices. California's Public Utilities Commission recently passed a rule that will raise residential power prices in the state by $24 per month to compensate for higher infrastructure costs (read "transmission upgrades to support renewables")[6]. Bloomberg Finance[7] and ThunderSaidEnergy[8] both estimate that a transmission line costs ~$2.7mm per km to build, and that the U.S. needs at least 5.5mm more kilometers of new/upgraded transmission. While it remains to be seen how much retail bills will increase due to transmission and infrastructure upgrades, the fact remains that these costs will be passed on to the retail consumer in the form of an adder to the retail electric bill.

Carbon offsets are also another source of power price increase. The US permits carbon allowances, or certificates, for the right to emit carbon from fossil fuel burning power plants. This is simply a "carbon tax", or an expense to emit CO2 during the transition from fossil fuels to renewable energy. The COP 28 Paris Accord has agreed that allowances are an integral part of the transition to a carbon-free economy[9].

The "cap & trade" carbon allowance programs are designed to reduce carbon emissions by providing fewer allowances and raising the floor price each year. However, with the slower-than anticipated buildout of renewable generation in the US, fossil fuel generation is staying online for reliability issues. This will drive up the demand for carbon allowances, and forecasts

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are for prices to more than double in the next 10 years[10]. These carbon cost increases are not yet reflected in retail power prices.

TRANSMISSION COSTS ($/MWHr) ESTIMATION

AMOUNT	ITEM	SOURCE
$2,700,000	cost per km	https://www.bnef.com/shorts/sc557adwrgg000
5,500,000	incremental km transmission lines needed by 2050	https://www.bnef.com/shorts/sc557adwrgg000
$14,850,000,000,000	notional cost of transmission	https://www.euci.com/more-than-43000-miles-of-new-transmission-lines-needed-in-the-u-s-by-2040-doe-stu
100	years amortization	
$148,500,000,000	annualized transmission cost	
3,927,169,069	residental MWHrs consumed in 2022	https://www.eia.gov/energyexplained/electricity/electricity-in-the-us-generation-capacity-and-sales.php
$38	cost per MWHr	https://www.eia.gov/electricity/annual/html/epa_02_02.html

POTENTIAL CARBON ALLOWANCE ADDER TO US POWER PRICES

		2023	2024	2025	2026	2027	2028	2029	2030	
	MWHrs US	3,972,000,000	4,091,160,000	4,213,894,800	4,340,311,644	4,470,520,993	4,604,636,623	4,742,775,722	4,885,058,993	https://www.eia.gov/energyexplained/electricity/use-of-electricity.php
0.37	Metric Tons CO2/MWHr	1,483,372,595	1,527,873,773	1,573,709,986	1,620,921,286	1,669,548,925	1,719,635,392	1,771,224,454	1,824,361,188	https://www.epa.gov/system/files/documents/2024-01/egrid2022_summary_tables.pdf
	Carbon Price/Ton	$42.00	$45.00	$47.00	$50.00	$60.00	$70.00	$80.00	$93.00	https://www.ettrends.com/climate-insights-channel/california-carbon-consensus-kccas-breakout/
	Notional Carbon Price	$62,301,649,002	$68,754,319,791	$73,964,369,358	$81,046,064,296	$100,172,935,470	$120,374,477,457	$141,697,956,320	$169,665,590,449	
	Carbon Adder per MWHr	$15.69	$16.81	$17.55	$18.67	$22.41	$26.14	$29.88	$34.73	
	Incremental		$1.12	$0.75	$1.12	$3.73	$3.73	$3.73	$4.85	

Potential Consequences

Higher retail prices are the natural consequence of historical price growth, supply/demand imbalance, reliability issues and upgrade cost pass-throughs. Forward power prices are beginning to reflect these factors, but have not yet fully captured them. When they are fully incorporated into retail power prices, the results for the end-user could be shocking.

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SAMPLE ESTIMATOR FOR RETAIL ELECTRIC BILL

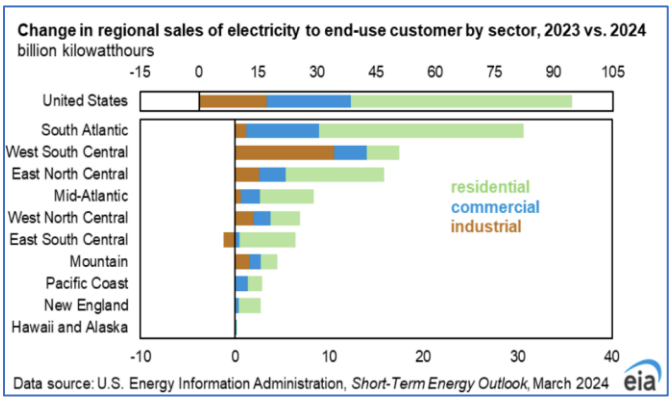
Retail Cost Estimator

		2022	2023	2024	2025	2026	2027	2028	2029	2030
Energy cost	$/MWh	62.21	48.52	49.20	64.57	67.20	69.91	70.22	71.37	72.22
TDSP	$/MWh	43.66	47.75	50.58	53.58	56.75	60.11	63.68	67.45	71.45
Rep Fee	$/MWh	5.00	5.00	5.10	5.20	5.31	5.41	5.52	5.63	5.74
Other passthrough	$/MWh	4.84	6.62	4.09	4.69	7.09	7.22	6.99	7.11	6.96
Taxes	$/MWh	4.82	4.50	4.54	5.33	5.68	5.94	6.10	6.32	6.52
Total	**$/MWh**	**120.53**	**112.38**	**113.51**	**133.37**	**142.03**	**148.60**	**152.51**	**157.88**	**162.89**

Key assumptions

Energy pricing reflects ERCOT North Hub
Oncor residential tariffs used for the analysis - post 2023, tariffs are grown at prevailing 3-year CAGR of 5.9%
REP fee represents a basic assumption for non-risk product - costs passed through and REP bearing no fixed price risks - fees grown at 2% CAGR
Other passthrough represents non-tradeable products (AS, PCM, FFSS, RENA, RUC, etc.) - all but PCM and AS obligation grown at 2% CAGR
AS includes DRRS service from 2025 onwards
PCM assumed to be implemented in 2026
Taxes are inclusive of Gross Receipts, Sales, and PUCA

The carryover would be how the consumer reacts – electricity is not an elastic commodity, and there is no demand substitute. As the average residential consumer continues to experience "the electrification of America", whereby electricity is increasingly leveraged to fuel appliances and other commonplace services, overall demand for electricity will increase, driving not only grid-infrastructural needs but also higher unit-volume prices for electricity, as a commodity. In short, the average consumer's lifestyles will wear an increased demand for electricity and at higher costs.



There are myriad consequences to higher retail power prices. Several recent examples include Winter Storm Uri (Feb '21); Bomb Cyclone '18 (bitter cold in Northeast); and Winter Storm Elliott (Dec '22 blizzards) – all resulting in higher power prices, widespread outages and loss of life attributable to lack of electricity.

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Higher retail power prices seem to be on the horizon, and consumers could start to see this reflected in upcoming electricity bills. An unfortunate consequence is the inability of some consumers to pay. Currently, a substantial amount of end-users are behind on their electricity payments (and by a significant amount).

Higher expected retail power prices will only make this worse:

AMERICAN HOUSEHOLDS ARE BEHIND IN THEIR ELECTRICITY BILLS

Region	% in Arrears	Avg Dollar Amount in Arrears	Source
US	16%	$529	https://moneywise.com/investing/stocks/tsunami-of-shutoffs-20m-american-households-cant-afford-to-pay-their-utility-bills-on-time#:~:text=20%20million%20American%20households%20are,%24788%20on%20their%20utility%20bills&text=While%20we%20adhere%20to%20strict,page%20also%20provide%20us%20earnings.&text=The%20U.S.%20consumer%20price%20index%20rose%203.7%25%20over%20the%20last%20year.
CA	21%	$733	https://www.publicadvocates.cpuc.ca.gov/-/media/cal-advocates-website/files/press-room/reports-and-analyses/240119-caladvocates-q4-2023-quarterly-rate-report.pdf
NY	18%	$858	https://www.osc.ny.gov/reports/distribution-utility-arrears-new-york-state
TX	27%	$587	(private estimate)
MA	19%	$1,000	https://www.wgbh.org/news/local/2022-02-23/hundreds-of-thousands-of-mass-households-are-behind-on-utility-bills-as-end-of-shut-off-moratorium-looms
IL	13%	$1,100	https://news.wttw.com/2023/06/23/consumer-advocates-utilities-spar-over-potential-energy-price-increases

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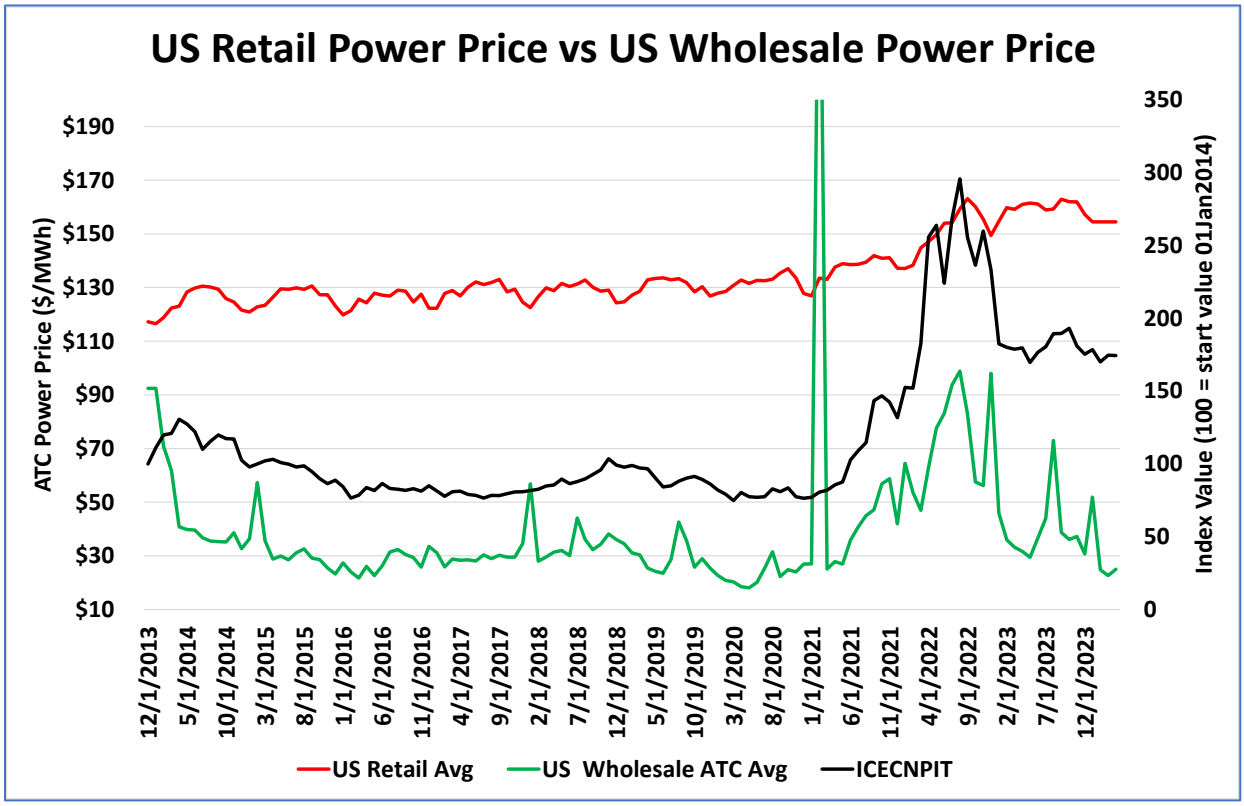
What to Watch

An interesting index exists, the ICE US Carbon Neutral US Power Futures Index, or "ICECNPIT". ICECNPIT consists of the 6 major US geographic locations to create a national index for electricity. The index also uses a 12-month strip of futures contracts, which mirrors the 1-year buying pattern of most residential customers.

Over the past 10 years, ICECNPIT provides a high correlation to the US Retail Power Price Average (82%). It also has a high correlation to inflation (~80%) and an interest rate component that reflects changing rates in the US.

The potential to use ICECNPIT in concert with retail exposure provides an exciting possibility.



CORRELATIONS (2014 thru 01May2024)	Retail	Wholesale	ICECNPIT
Retail	1.00	0.18	0.82
Wholesale	0.18	1.00	0.36
ICECNPIT	0.82	0.36	1.00

[1] Lazard, LCOE, 2023.
[2] WSJ 12May2024 "There's Not Enough Power For America's High-Tech Ambitions" https://www.wsj.com/business/energy-oil/data-centers-energy-georgia-development-7a5352e9?mod=energy-oil_more_article_pos3
[3] Bloomberg 14May2024 "California Restaurants Stall Climate Progress Over Gas Stoves" California Restaurants Stall Climate Progress Over Gas Stoves | BloombergNEF (bnef.com)
[4] World Resource Institute 03May2024 "4 Things To Know About US EPA;s New Power Plant Rules" https://www.wri.org/insights/epa-power-plant-rules-explained#:~:text=In%20the%20final%20rules%2C%20the,extend%20their%20lifetimes%20beyond%202039.
[5] Inside Climate News 23Geb2024 "Community Opposition and Grid Challenges Slow The Pace Of Renewable Efforts" https://insideclimatenews.org/news/23022024/community-opposition-and-grid-challenges-slow-pace-of-renewable-efforts/
[6] Bloomberg News 09May2024 "California Adopts One of nation's Highest Fixed-Utility Fees" https://www.bloomberg.com/news/articles/2024-05-09/california-adopts-one-of-nation-s-highest-fixed-utility-fees?sref=CPH8JEoS
[7] Bloomberg 02May2024 "New US Power Lines Cost Up To $2.7 Million Per Kilometer: BNEF file:///E:/BCOM-Green/State%20Street/White%20Papers/Retail/Transmission%20Costs%2027mm.pdf
[8] ThunderSaidEnergy 08May2024 "Transmission Costs: Our Top Five Facts" https://ml.thundersaidenergy.com/emails/webview/741255/120759383379412447
[9] United nations Climate Change 10Dec2023 "Unlocking Climate Ambition: The Significance of Article 6 at COP28" https://unfccc.int/news/unlocking-climate-ambition-the-significance-of-article-6-at-cop28
[10] S&P Global 13Mar2024 "A Tale of Two Carbon Markets" https://www.spglobal.com/en/research-insights/featured/special-editorial/look-forward/a-tale-of-two-carbon-markets