March 20, 2023

BitOoda

Power Markets for Bitcoin Miners, 3/20/23

EIA Annual Energy Outlook

The Energy Information Agency released its Annual Energy Outlook (AEO) last week. The key new part of the forecast is the impact of the Inflation Reduction Act (IRA). Not all the pieces of the IRA are addressed in the outlook, as there are some nuances in modeling some of the legislation, but nonetheless the bill is shown to have a significant impact on the energy outlook.

The IRA certainly altered how the EIA presents the AEO. In years past, the starting focus was the energy balance, typically starting with oil & gas related issues. This report begins with the power sector, then focuses on electrification of the system. In other words, power is now leading the AEO, as opposed to being an afterthought as it was for so many years.

Key Takeaways

- *The EIA released the Annual Energy Outlook (AEO) with a focus on the Inflation Reduction Act (IRA).*
- *The AEO presents the impact of the IRA, which it assesses is equivalent to half the impact of the economic high and low cases.*
- *Solar and storage growth is a key driver in the outlook.*
- *Missing elements are the flattening of EV adoption and the lack of discussion on mining and compute demand.*
- *The oil & gas sector is expected to be a net exporter, which changes the economic drivers in our policy.*
- *Mining economics are expected to continue to improve with the BTC rally.*
- *Natural gas markets are slightly down in the prompt – power saw minor changes week on week.*

https://www.eia.gov/outlooks/aeo/

Research

David Bellman[ac]
Power & Carbon Research
dbellman@bitooda.io

Tim Kelly | Head of Sales
Sam Doctor | CSO, Head of Research
Vivek Raman | Proof of Stake
Mike Tauckus | Head of Trading

BTC Price 7 day Avg	$23,994
Hashrate 7 day Avg	327 EH/s
PJM Cal 24	49 $/MWh
NYISO Cal 24	58 $/MWh
ERCOT Cal 24	43 $/MWh
CAISO Cal 24	76 $/MWh

Weekly Variable Economics $/TH

c/kWh	S9	S19j
$0.02	$0.09	$0.34
$0.03	($0.10)	$0.28
$0.04	($0.28)	$0.21
$0.05	($0.47)	$0.15
$0.06	($0.66)	$0.08
$0.07	($0.85)	$0.02
$0.08	($1.04)	($0.05)
$0.09	($1.23)	($0.11)
$0.10	($1.42)	($0.18)
$0.11	($1.61)	($0.24)
$0.12	($1.80)	($0.31)
$0.13	($1.98)	($0.37)
$0.14	($2.17)	($0.44)
$0.15	($2.36)	($0.50)

EIA Annual Energy Outlook

CO2 Emissions

- The chart below shows CO2 emissions and the impact of the IRA legislation, which is quite significant: it is half of the impact of the economic high and low cases.

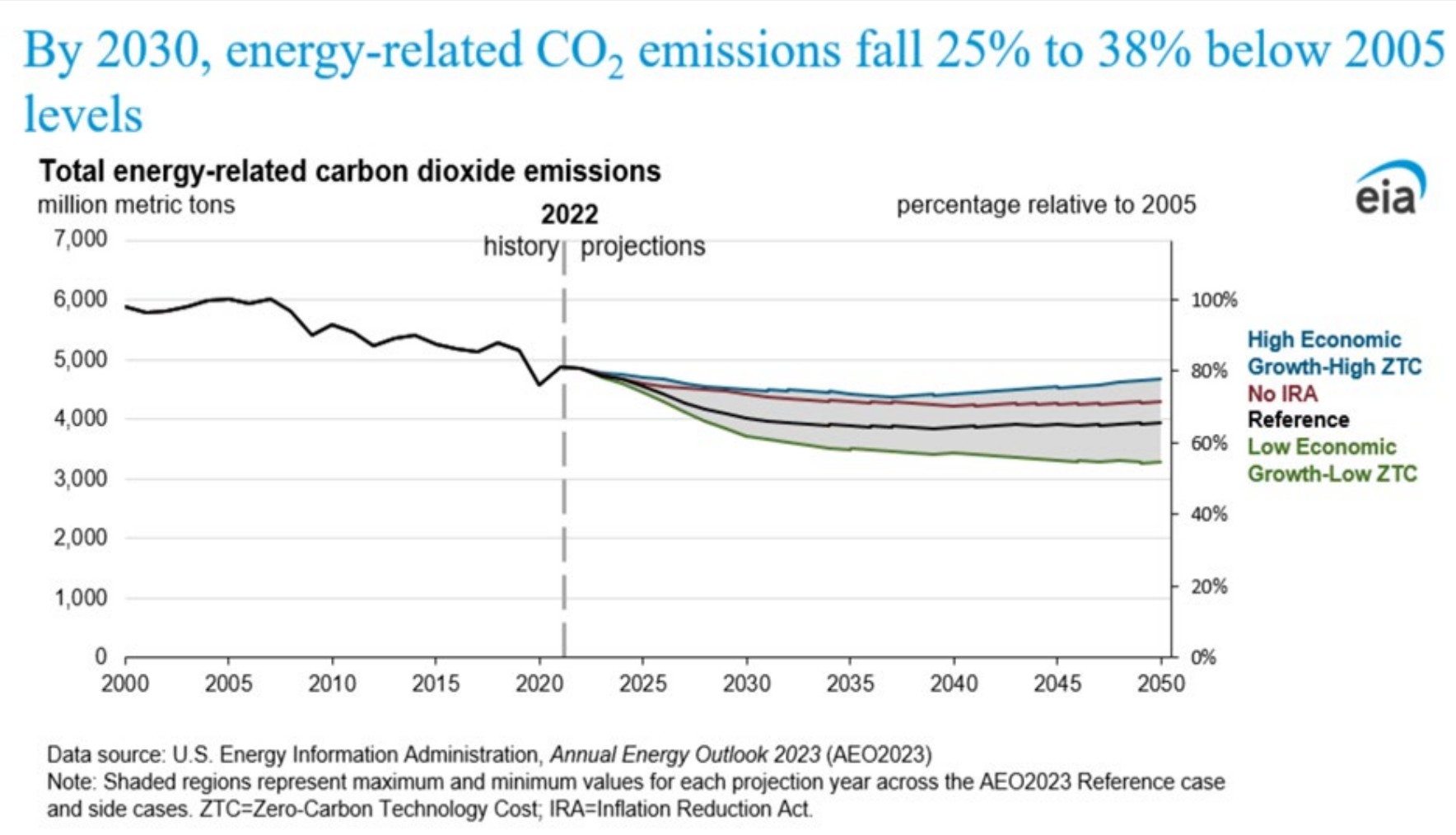


Figure: Total energy-related carbon dioxide emissions (million metric tons)

Source: Energy Information Administration

EIA Annual Energy Outlook

Renewables Growth

- The greatest impact for the future power world, with or without the IRA, will be the adoption of solar power generation and storage.
- As noted in the below graphic, the only source with significant growth potential is solar. Power demand is increasingly met by renewables. This growth is based not only on incentives from the government, but also the natural economics of the reduced cost of solar when compared with the alternative cost of grid power.
- The grid/utility power cost structure is now surpassing the economics of solar installation in several parts of the country.

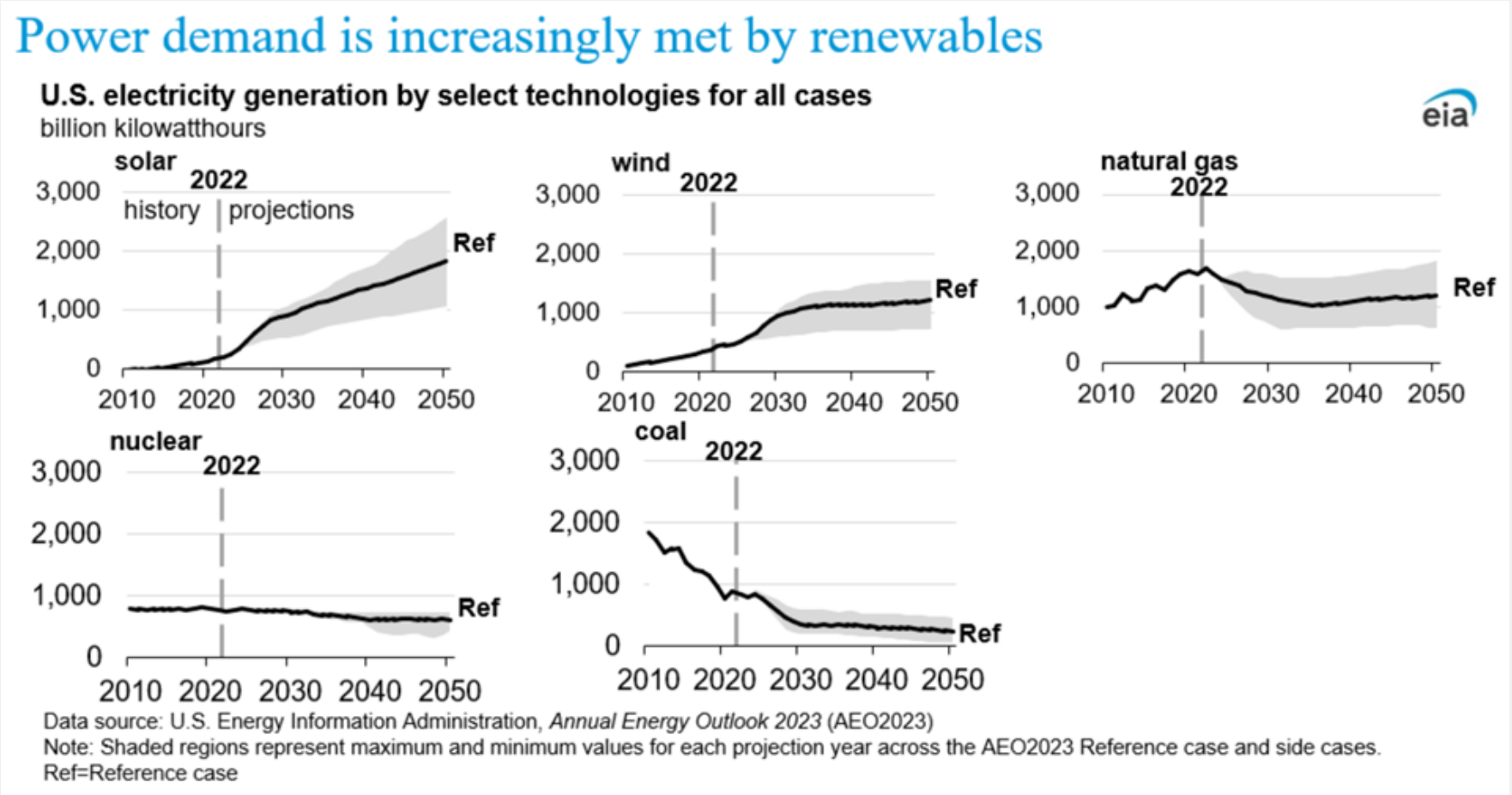


Figure: US electricity generation by select technologies for all cases (billion kWh)

Source: Energy Information Administration

EIA Annual Energy Outlook

Value of Storage

- With the increase in renewable energy, the AEO correctly concludes that the value of storage is growing, and hence storage installations will be increasing.
- Storage offers value beyond just the price incentives, also offering backup power for grid reliability.

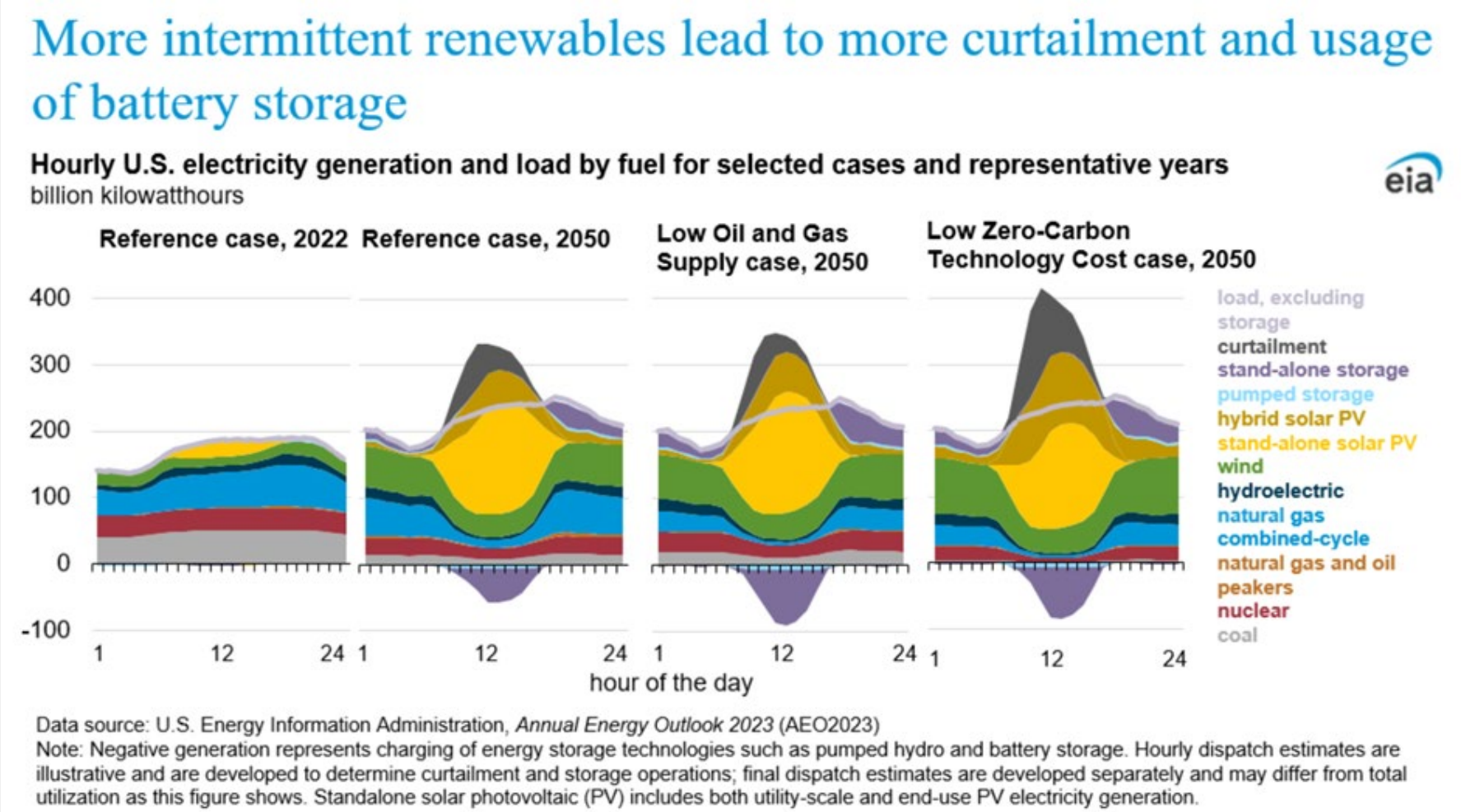


Figure: Hourly US electricity generation and load by fuel for selected cases and representative years (billion kWh)

Source: Energy Information Administration

EIA Annual Energy Outlook

EV Adoption & Compute Power

- One the biggest points of divergence in our view is the EV adoption curve.
- Past 2030, new EV sales in the report flatten out below 20%. There has never been a technology that flattens out like that, considering the benefits and scale of adoption. Looking at other technologies that enter the consumer space and offer benefits, we typically don't see a plateau at 20%.
- Another gap in the AEO is the fact that there is no mention of compute or bitcoin mining. A discussion of power without a discussion of growth related to compute power leaves a glaring hole.

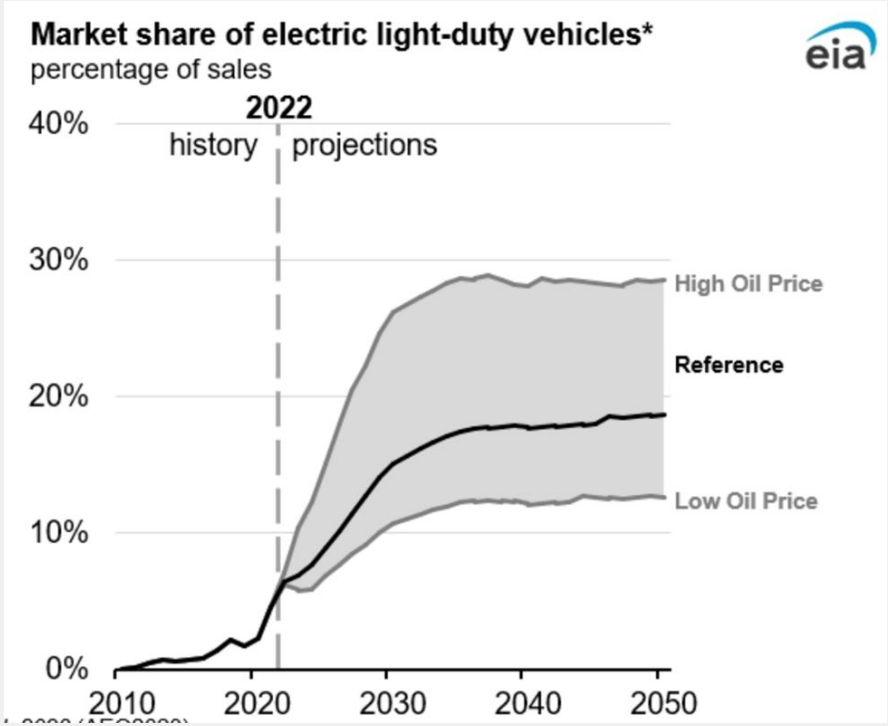


Figure: Market share of electric light-duty vehicles (% of sales)

Source: Energy Information Administration

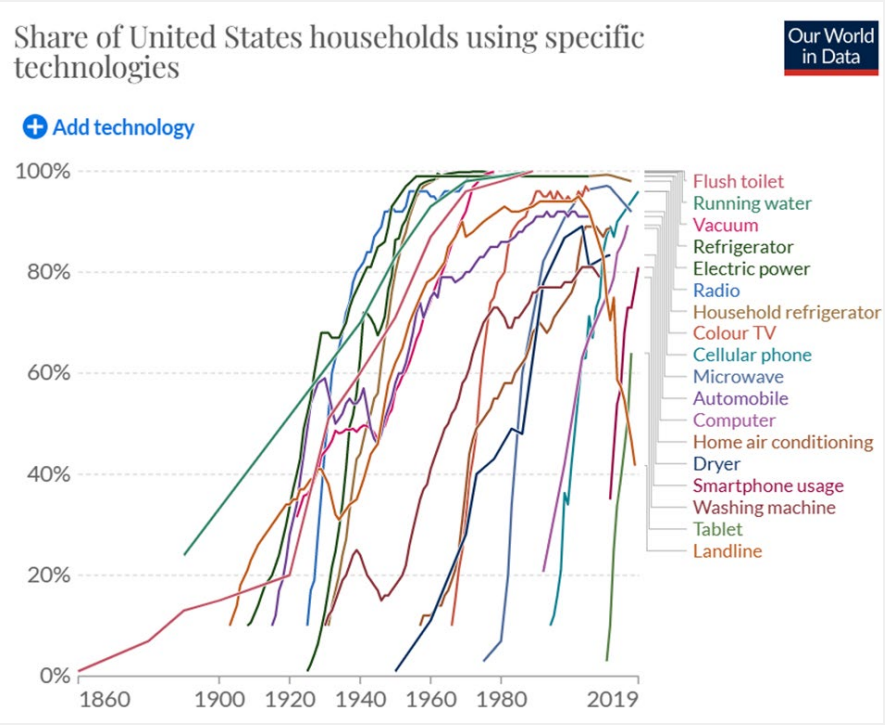


Figure: Share of US households using specific technologies (% of sales)

Source: Our World In Data

EIA Annual Energy Outlook

Oil & Gas

- By chapter three, the report finally gets to oil and gas. The oil discussion is quite brief compared to the natural gas discussion.
- The key takeaway is that the US will continue to be a net exporter of petroleum products through 2050, including being a natural gas exporter via LNG.
- Our shift from being an importer to exporter changes the economic drivers of our policies.

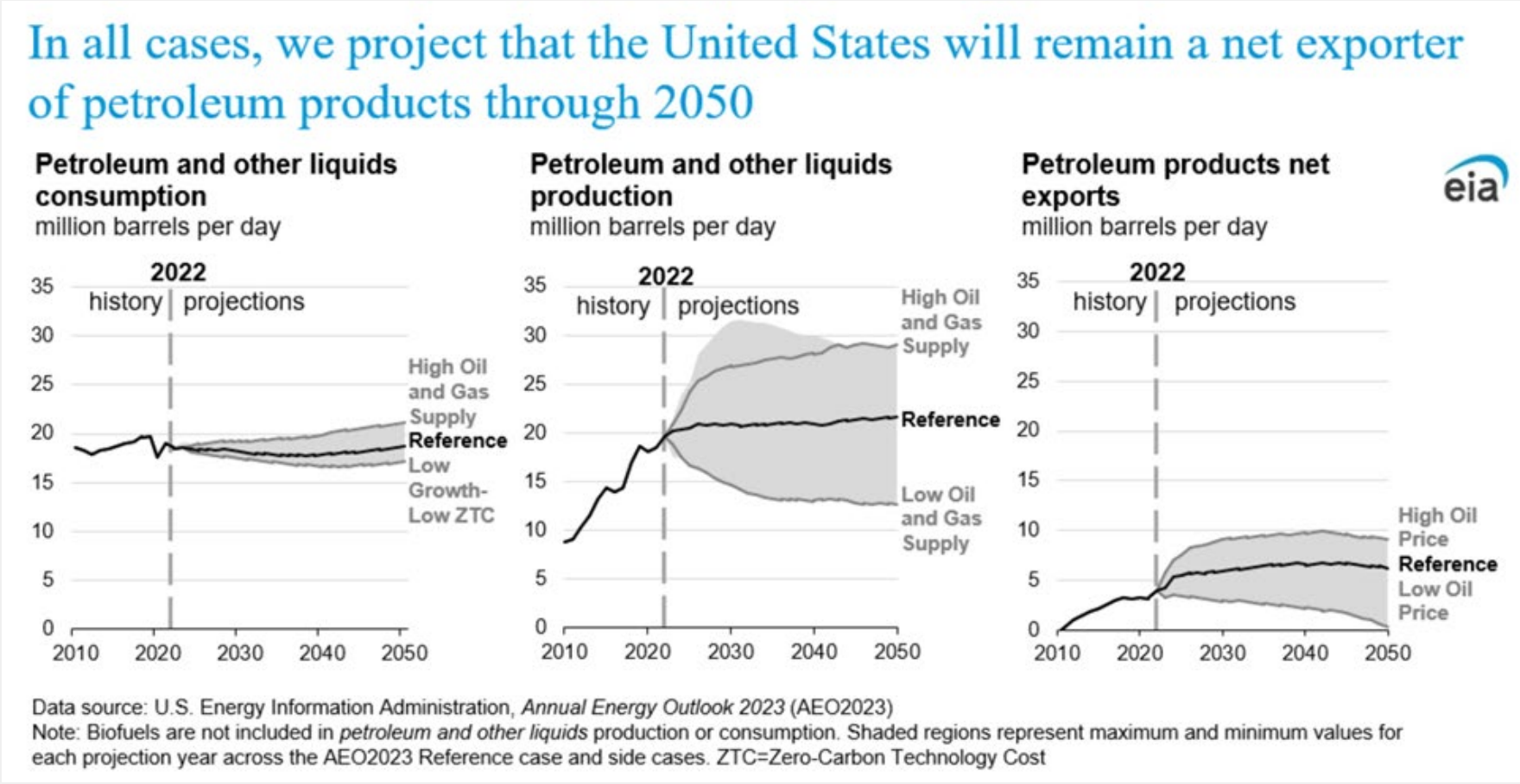


Figure: Petroleum and other liquids consumption, production, and net exports (million barrels / day)

Source: Energy Information Administration

EIA Annual Energy Outlook

LNG Exports & Consumption

- Liquefied natural gas exports drive production.
- Domestic consumption remains stable.

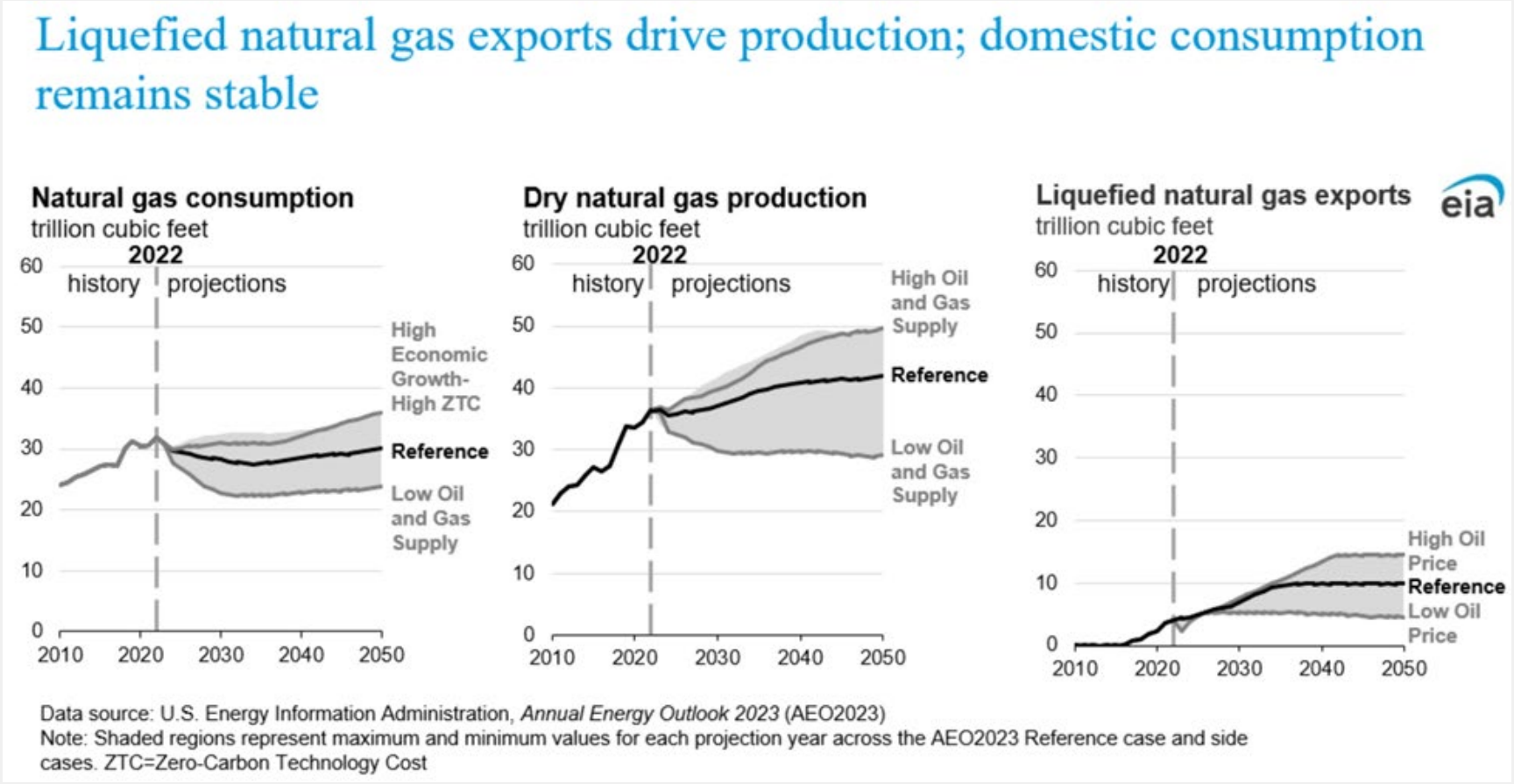
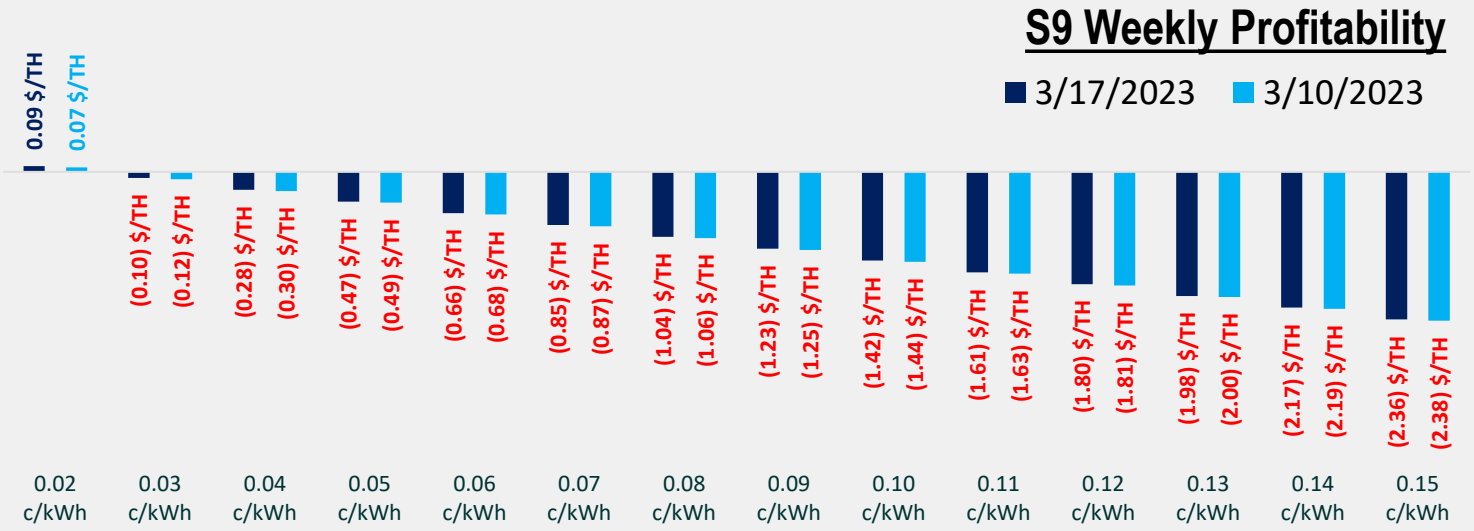


Figure: Natural gas consumption & production, Liquefied natural gas exports (trillion cubic feet)

Source: Energy Information Administration

Miner WoW View

- Mining economics improved and will likely continue with the recent rally in BTC.
- The S19JPro breakeven price is between $70-$80/MWh.



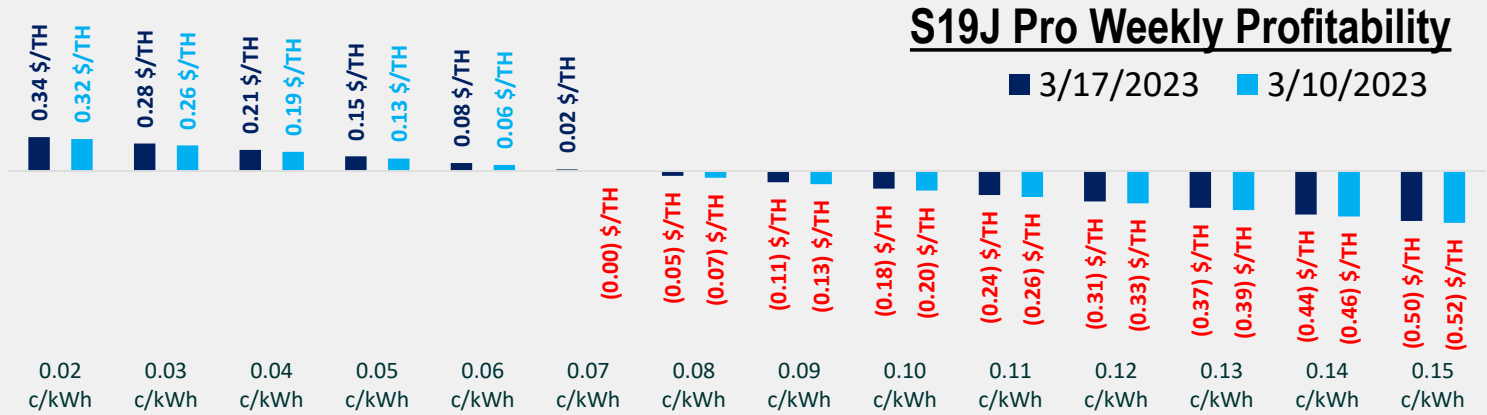
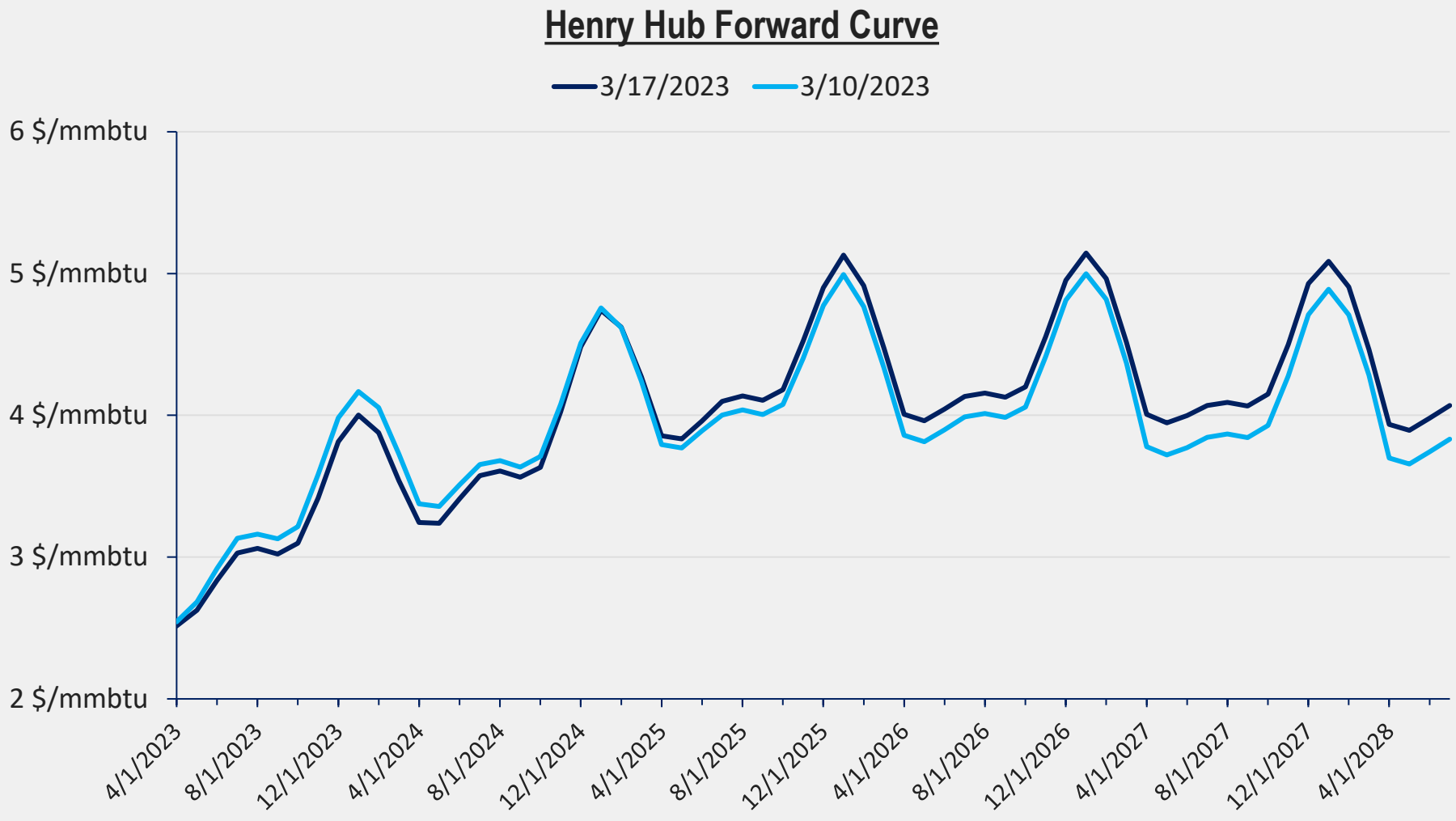


Figure: Weekly Average Cash Contribution After Power Expense
Note: Assumes a PUE of 1.12

Source: BitOoda, Bloomberg, Coinmetrics

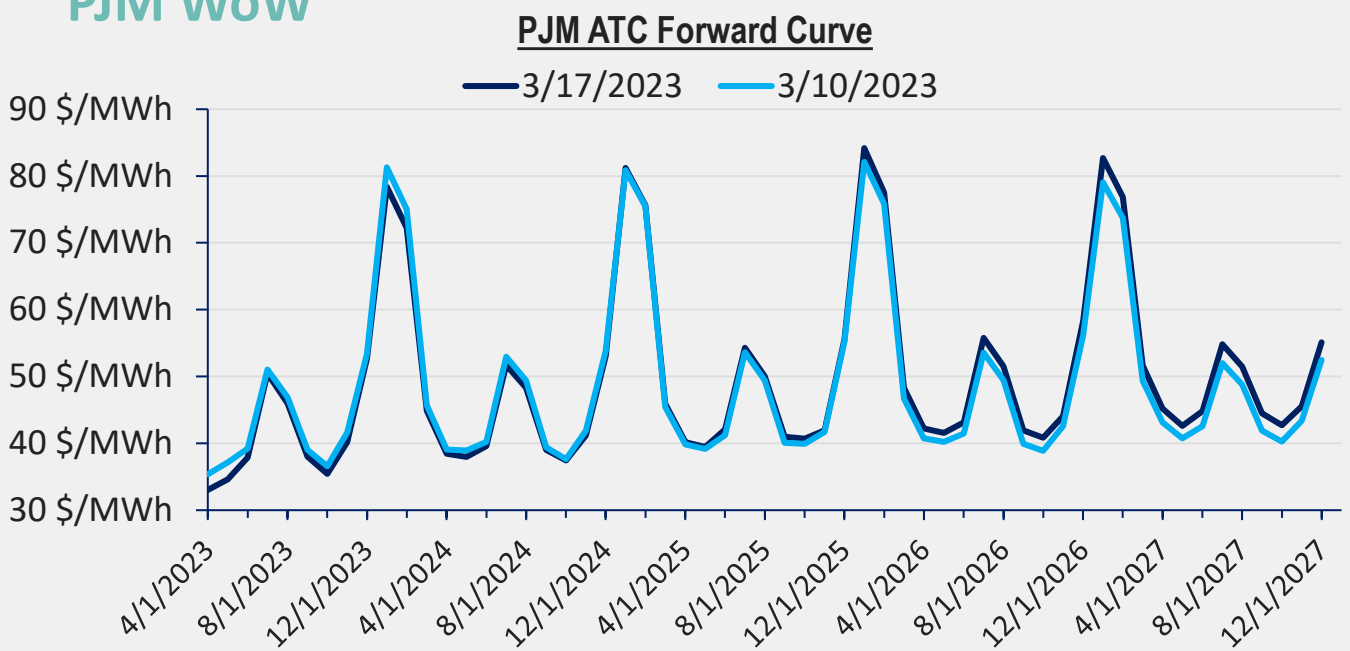
Henry Hub WoW

- The curve is slightly down in the near term. Past 2025, we see it climbing.

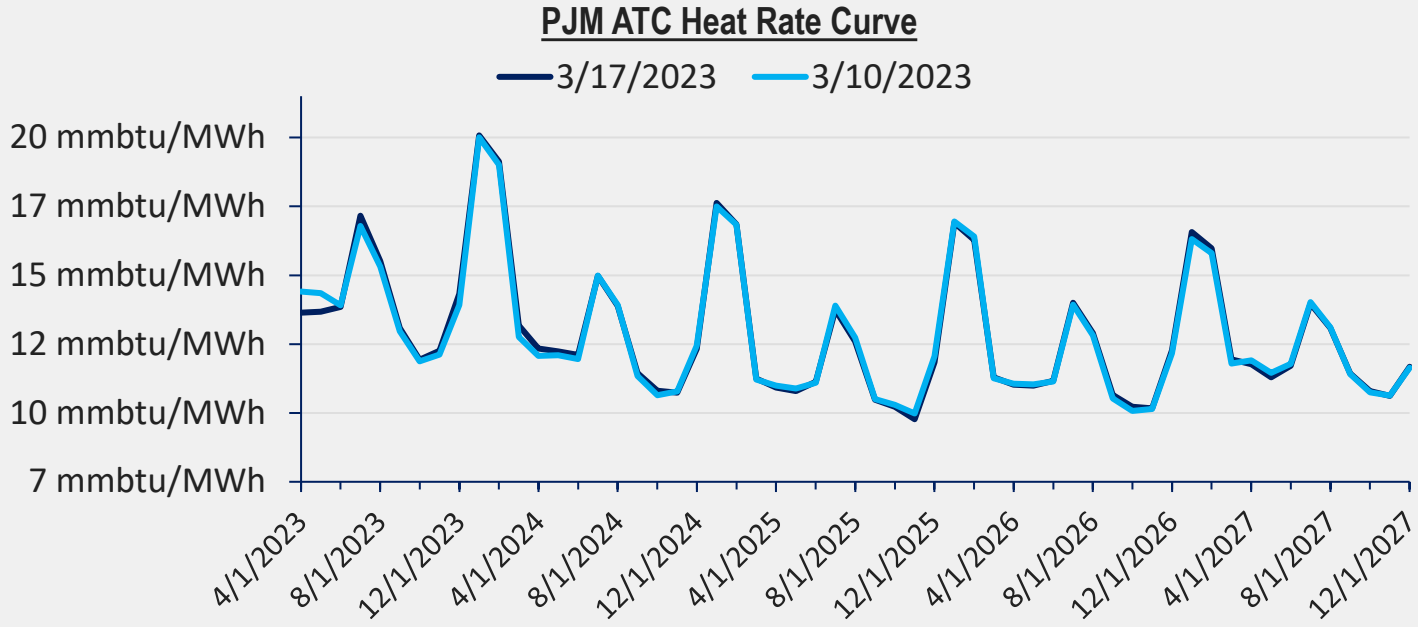


Source: BitOoda, CME Group

PJM WoW

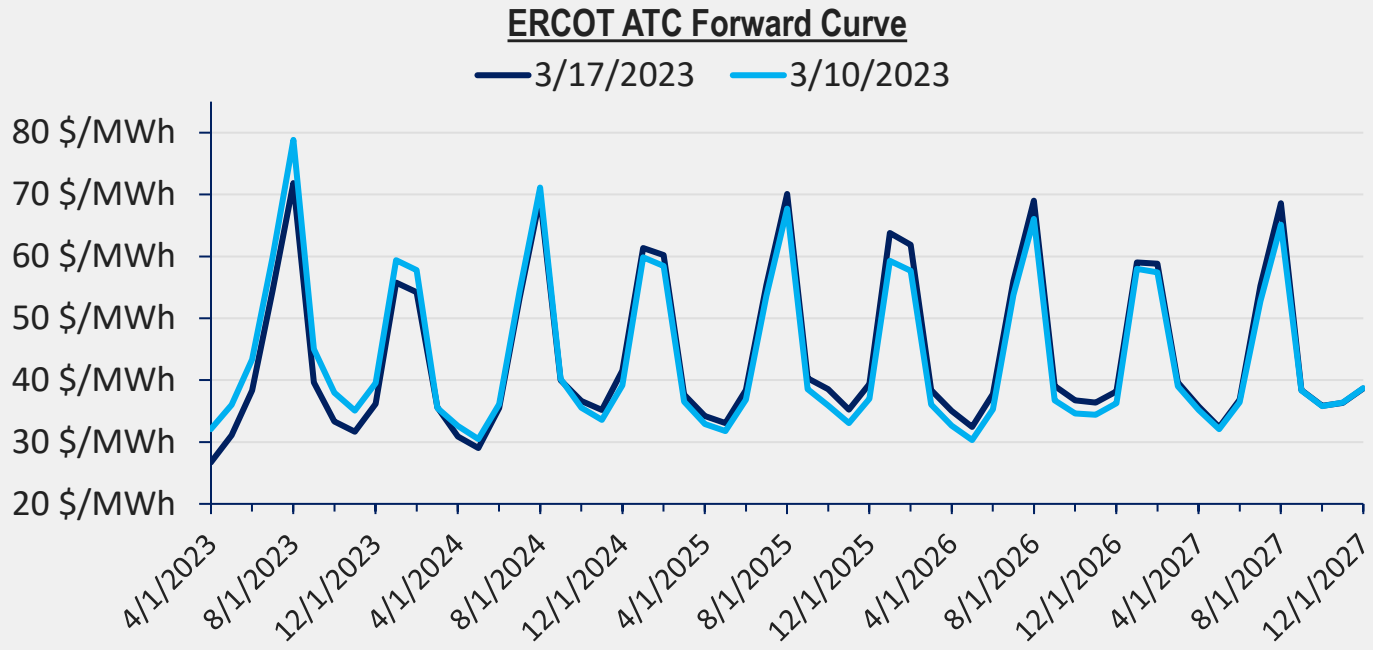


- For the PJM region, we use PJM-W hub as the benchmark. PJM-W is the most traded power hub in the US.
- Power is slightly down in the prompt.

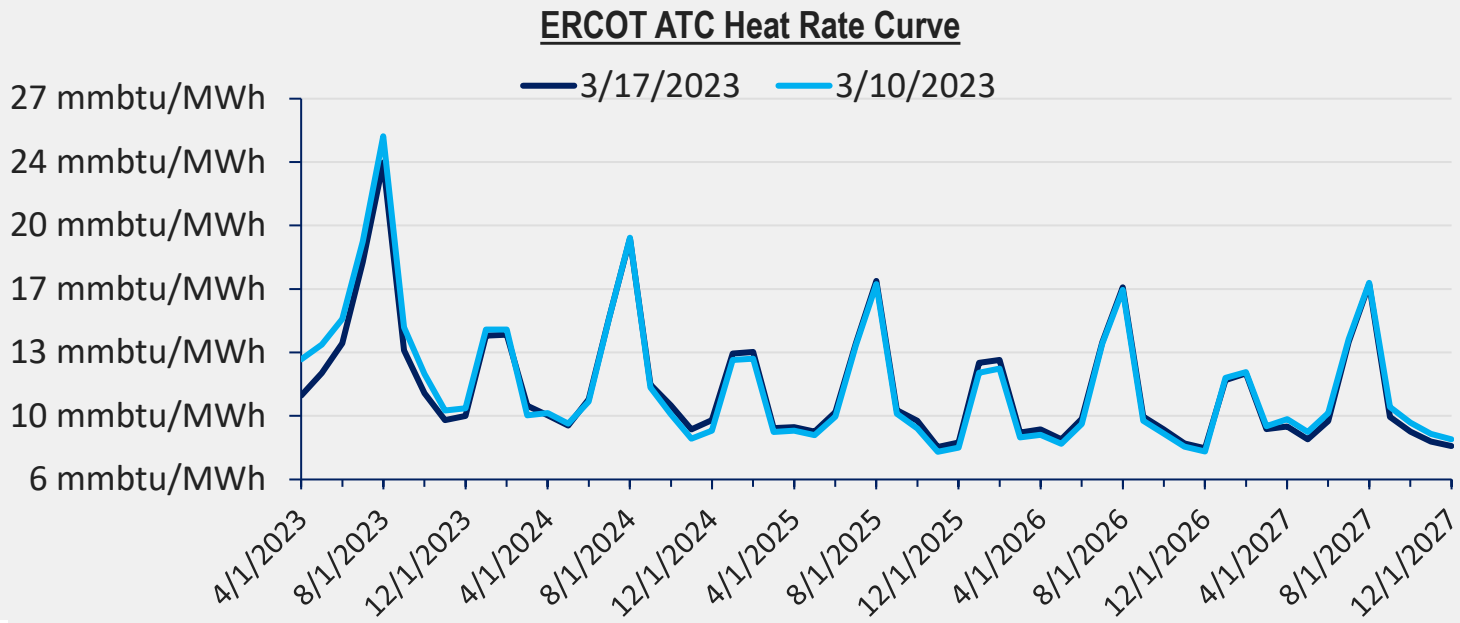


Source: BitOoda, CME Group

ERCOT WoW

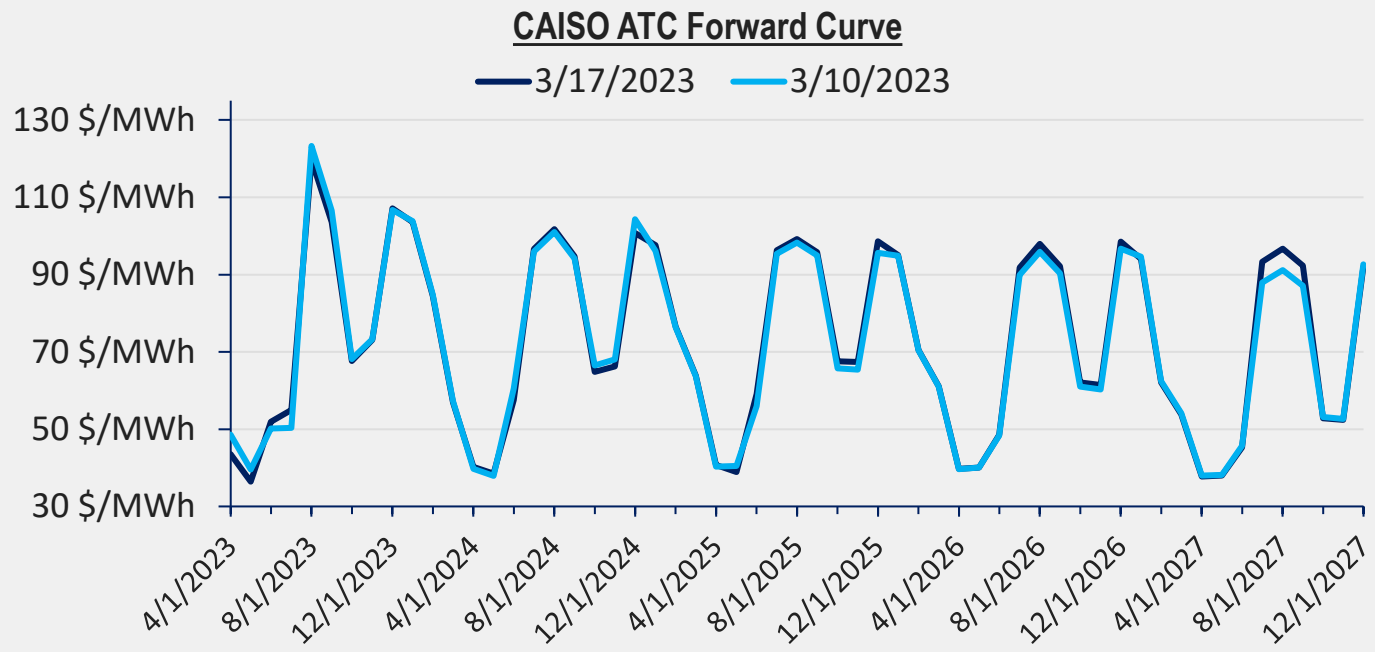


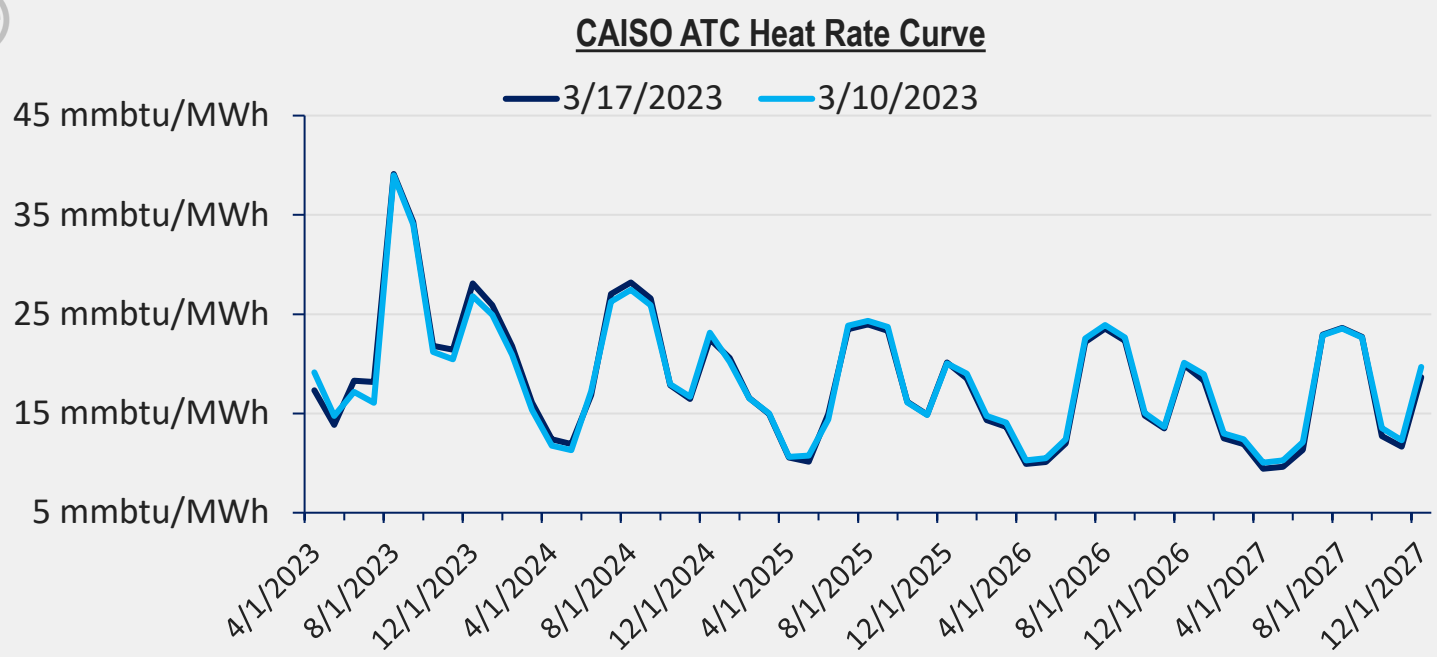
- For the ERCOT region, we use ERCOT-North hub as the benchmark. ERCOT-North is the most traded power hub for ERCOT.
- Similar to PJM, ERCOT power prices moved up, increasing HR.



Source: BitOoda, CME Group

CAISO WoW

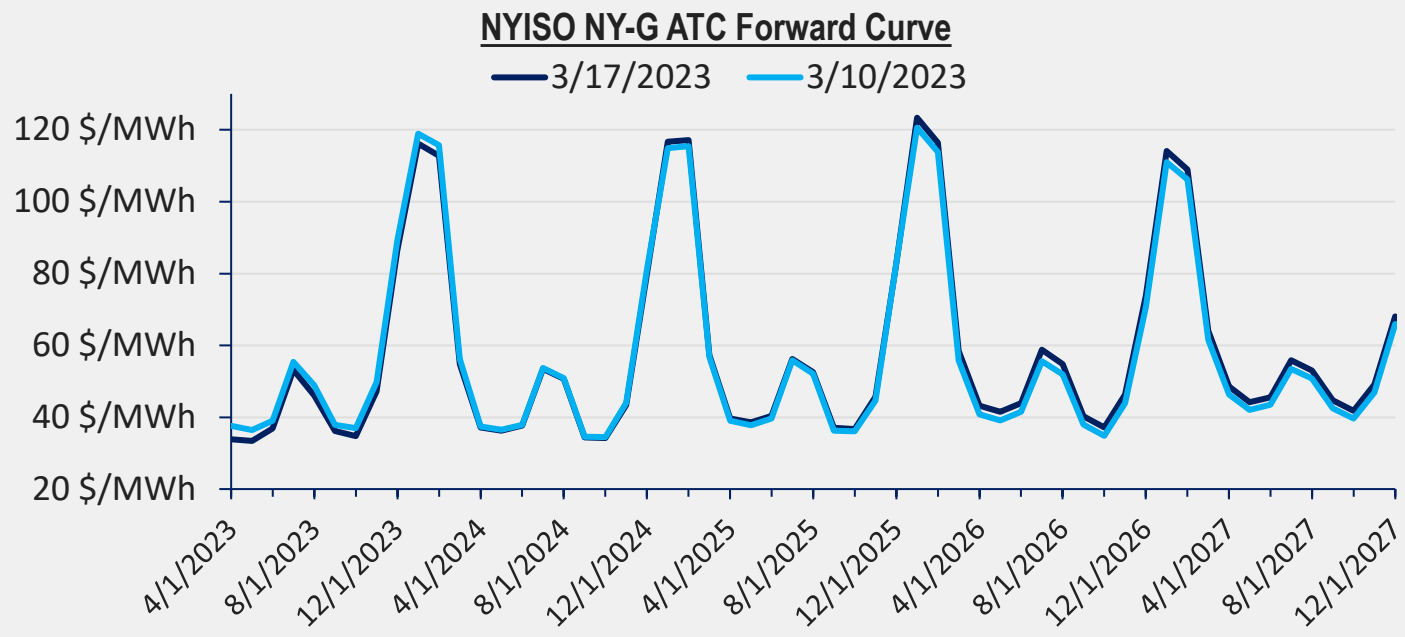


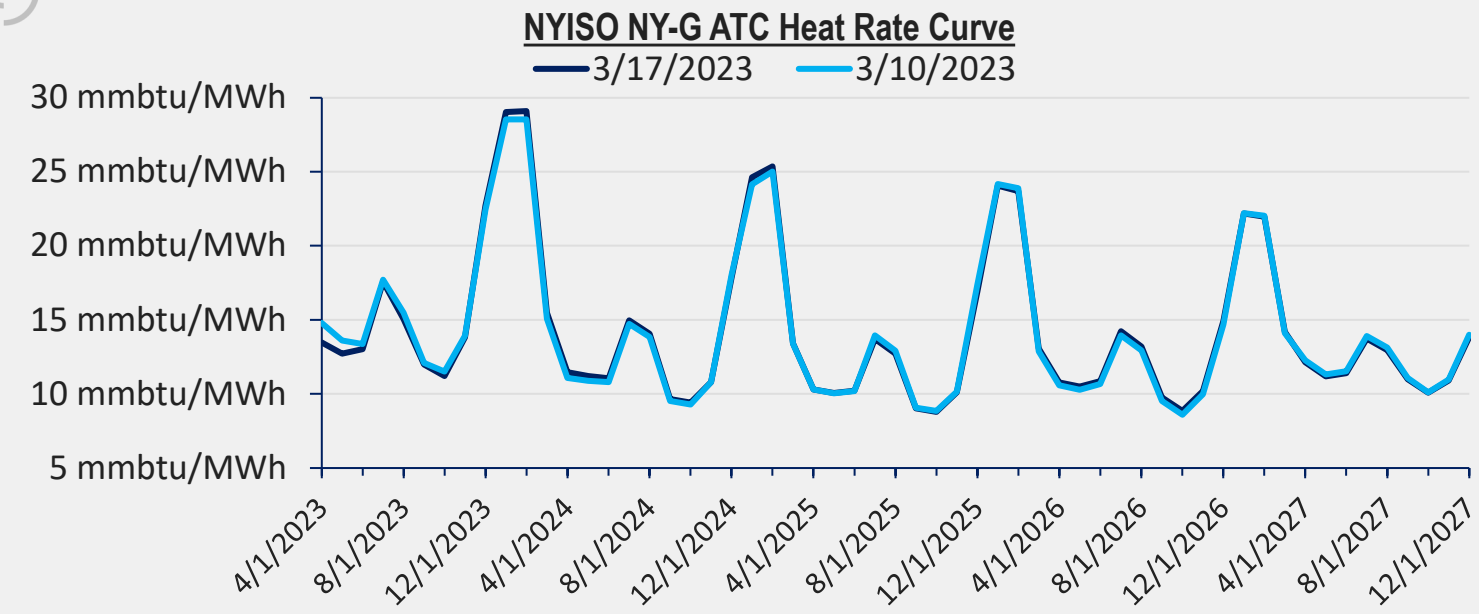


- For the CAISO region, we use SP-15 hub as the benchmark. SP-15 is located in Southern California.
- Not much changed in CAISO over the past week.

Source: BitOoda, CME Group

NYISO WoW: NY-G

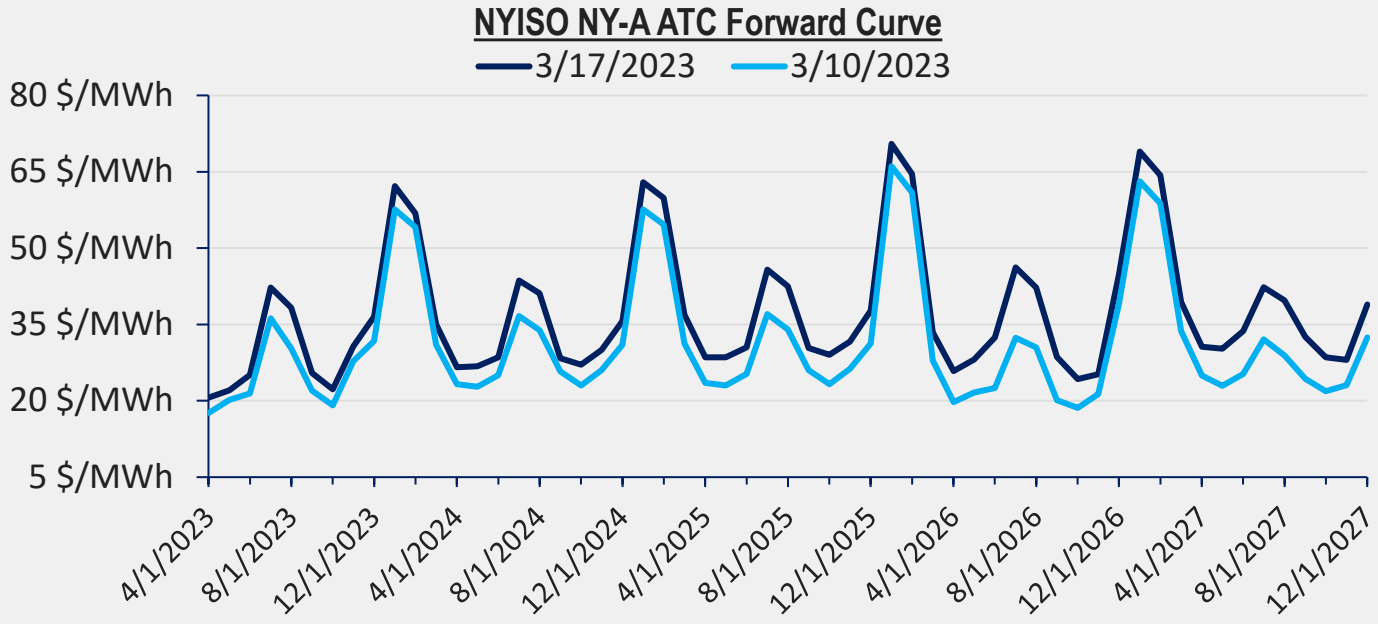


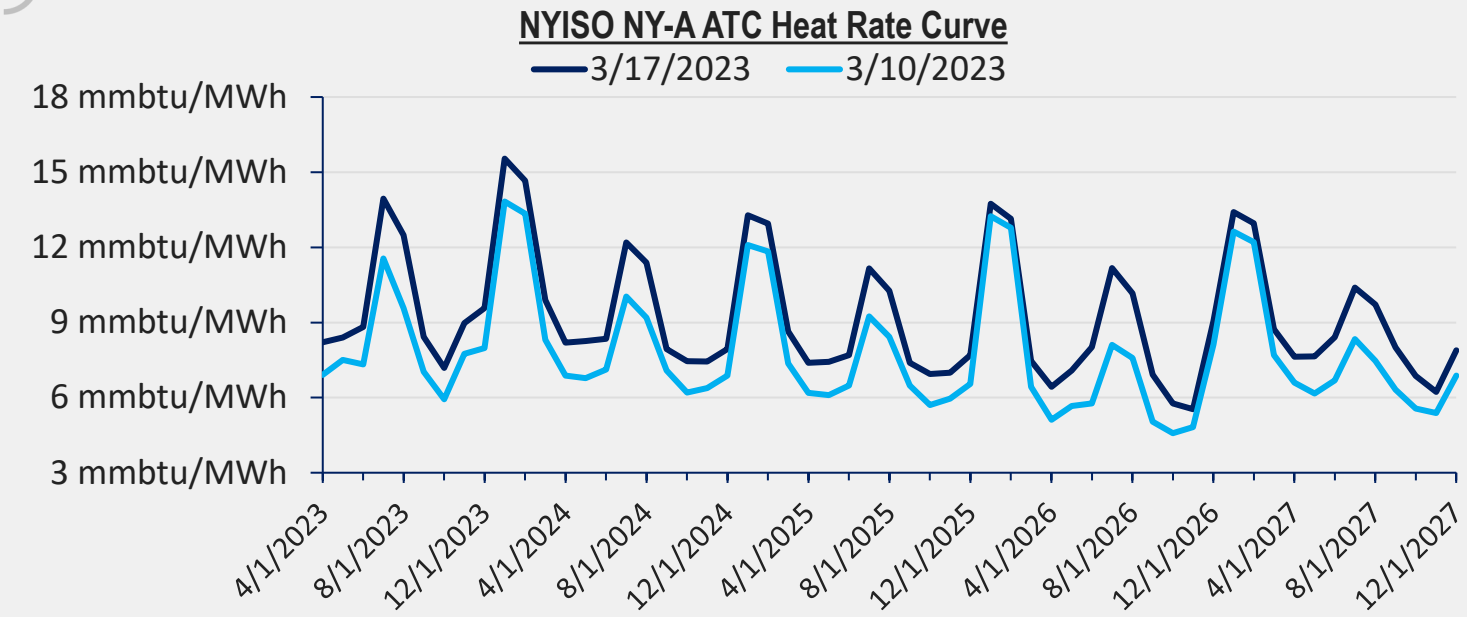


- This slide uses the NY-G hub as the benchmark for the NYISO region. NY-G is the most traded power hub in NYISO.
- NYISO saw only minor changes.

Source: BitOoda, CME Group

NYISO WoW: NY-A





- This slide adds NY-A for the NYISO region.
- NY-A is up and moving on its own again.

Source: BitOoda, CME Group

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