

Impacts and Implications of COVID-19 for the Energy Industry

Assessment through April 2020

PREPARED BY

Frank Graves

Tess Counts

Josh Figueroa

Bob Mudge

Shivangi Pant

Lily Mwalenga

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THE **Brattle** GROUP

PURPOSE and CAVEATS

This report provides an update to our [initial compilation and assessment](#) of the initial impacts of COVID-19 on electric and natural gas utilities in early April. Like our prior report, it reflects a review of many sources of information, with public health, economic, and industry data changing considerably day by day. The goal is to make a broad overview of energy industry implications available in one document, rather than to offer a detailed forecast or opinion. Data sources are considered reliable but have not been independently validated by Brattle. Doubtless, some important sources of information have been overlooked.

The pandemic continues to have devastating effects on healthcare, education, business activity, and employment. However, social distancing regimes may now have reached their most stringent levels around most of the country and in some states are being relaxed. Barring a major second wave of infections, it is reasonable to suspect we have seen as much energy demand destruction as will occur as a direct effect of social distancing. If this is the case, the observed energy demand reductions may be approaching a bottoming out.

However, lingering and more difficult questions about the indirect effects of COVID-19 involve how quickly we can get back to more normal commerce, how much irreversible destruction of businesses will have occurred, and how demand patterns (consumption habits) may change over the long term. Also, summer impacts of similar social distancing, if needed then, might be much larger in percentage terms due to lost cooling loads. Thus the demand destruction in April may understate the eventual impact on electric and gas utilities.

This assessment reflects the perspectives and opinions of the authors and does not necessarily reflect those of The Brattle Group's clients or other consultants.

Agenda

Section 1: Executive Summary – What Has Changed Since March

Section 2: COVID-19 Path and Macroeconomic Projections

Section 3: Energy and Financial Sector Impacts

- Oil & Gas demand and prices
- Electricity loads, load shapes, prices, and utility revenues
- Regulatory reactions
- Generation mix impacts
- Financial impacts on valuations, interest rates, risk

Frame of reference: We have treated February 1, 2020, as the beginning of the significant influence of COVID-19 on the US economy. Energy data has not been weather-normalized, so we use (where relevant) the average of a few years' prior history for comparison.

1. Executive Summary

COVID-19 related deaths flatten in April, while U.S. unemployment grows sharply

The Pandemic:

- The growth rates of infections and daily deaths have significantly declined in April versus March as social distancing helped to flatten the curve relative to hospital capacities.
- But US infection doubling rates are still higher than average internationally, and deaths per day have been relatively flat in April, with reductions in NY roughly offset by increases in the rest of the country, suggesting R_0 is not yet at or below 1.0.
- Expected total number of deaths by August has increased by over 50,000 deaths since IHME's April 5 forecast, increasing from 82k to 134k as of May 5th.

The Economy:

- Joblessness claims have grown to around 33 million, or about 20% unemployment, comparable to the depths of the Great Depression (but many of the lost jobs are “temporary” and about half are getting federal income replacement, unlike in the ‘30s).¹
- Most economic forecasts are showing a very deep Q2 GDP loss of 30-40% but sharp recovery in late Q3 through Q1 2021.
- The S&P 500 recovered roughly 85% of its value by April 30 compared to its peak on February 19, now at levels comparable to September 2019 with a P/E ratio around 20x on forward earnings.

Disruptions to the oil markets are affecting natural gas prices

Oil Markets:

- Oil prices traded negative (as low as -\$40/bbl) for the first time in history, but have since rebounded a bit. In April, US production is down about 900 thousand bpd but OPEC+ production increased by 1.6 million bpd ahead of planned 9.8 million bpd production cuts. Storage concerns persist.
- Oil futures for 2020-2026 have dropped another 5% on average since March, reflecting a longer disruption to the demand and production—not reaching \$50/bbl until 2026-2028.

Natural Gas Markets:

- Henry Hub front month prices increased slightly by \$0.05/mmBtu on average in April vs. March largely due to colder weather. Natural gas futures have increased 14% on average through March 2022, likely due to expected lower associated gas production. The 2020 summer/winter spread has expanded to over \$1.00/mmBtu.
- Natural gas residential and commercial demand (not included in previous report) has remained consistent with normal seasonal declines, showing no obvious COVID-19 effects. In fact, April R&C demand was somewhat higher than March, possibly due to colder weather, but average monthly Industrial demand was down 7% compared to 2019, possibly due to economic shutdowns.
- An estimated 25 LNG cargoes for June, equivalent to an estimated 80 bcf, and about half of last year's June volumes, have been cancelled due to lower global demand. LNG netback spot prices to Asia and Europe are below Henry Hub spot prices for gas.

Electricity load has declined by 6% in April, double the effect captured in March

Electric Energy Markets:

- All ISOs in our analysis are showing a COVID-19-caused reduction in electric load beyond seasonal effects, even though a few have total loads a bit above past year seasonal averages due to growth.
- Compared to March, there is about twice as much non-seasonal (assumed COVID-19-related) load loss in April compared to March (6.5% vs. 3.3%).
- Residential load is estimated to be up about 7% so the overall load reduction is concentrated in C&I customers, which would have to have declined about 15% due to COVID-19 to explain the overall 6.5% reduction.
- Month on month ISO load shapes show only modest overall changes – slightly lower, but not materially altered, except for CA, which has a flatter and higher mid-day and sharper evening ramp.
- Coal production fell to less than 20% of US generation in the first part of 2020, and may decline by 20-25% this year. Natural gas generation is down about 14% from March of this year but is up 4% compared to April 2019.
- There is little to no decline in renewable energy usage, but REC prices have fallen and project development may be delayed by supply chain issues and construction labor limitations.

Investment Has Not Shown Much Response, Yet

Demand for Capacity

General:

- Notwithstanding less energy demand, no discernable acceleration in retirements yet; US installed capacity remains flat;
- EIA projects COVID-19 will cause a 4.9 GW delay or cancellation of planned capacity expansions through September 2020;
- If recovery occurs in late 2020 and through 2021, demand could be about back to late 2019 levels with a two-year lag;
- This would delay, but not materially cancel, much expansion (barring bankruptcies or persistent drop in consumer demand).

Renewables-Specific:

- Capacity still growing at approximately 700 MW per month since January, reaching almost 13% of total US installed cap;
- This pace is somewhat below same period last year, which was 900 MW per month in Feb-April of 2019.
- Also, reported sectoral unemployment portends slowdown.

Other Investment Drivers

- Interest rates remain at historic lows, facilitating investment;
 - However, utility credit posture coming into question due to load reductions;
 - Lending criteria are becoming more stringent;
 - Supply chain disruptions affect whole economy;
 - Utilities can expect additional impact via recent presidential order on bulk-power procurement.
-
- Supply chain disruptions reported by renewable equipment manufacturers.²
 - Tax credit expiration and waning tax equity especially affects small developers;
 - Conditions ripe for M&A consolidation.

Monthly Impacts from Social Distancing May be Bottoming Out

Utility Financial Impacts:

- S&P 500 increased 18% in April; utility stock prices generally continued to follow this overall market trends upward but rose more slowly than the overall market.
- Utility revenue reductions should be smaller in percentage terms than load losses, because the residential increases produce corresponding revenue increases (under volumetric rates) while the much larger lost C&I load is partly softened in revenues by demand charges.
 - Also the COVID-19 impacts have occurred in an off-peak season, not yet impacting rate factors as much as they would (may still) in summer.
- Ten more states have imposed a mandatory moratorium on shutoffs, bringing the total number of states to 32. Many utilities have also begun applying for enhanced decoupling mechanisms to recover COVID-19 induced lost revenues towards fixed costs.
- 20-year utility bond spreads declined 80 bps in April but remain 42% higher than at the beginning of the year.
- S&P downgraded its credit outlook for investor owned utilities to negative but with only 3 rating reductions. Moody's affirmed stable outlook for public power companies.
- Market Volatility Index (VIX) averaged over all days of April has decreased to about the average level seen in the 2008/09 Great Recession.

2. COVID-19 Path and Macroeconomic Projections

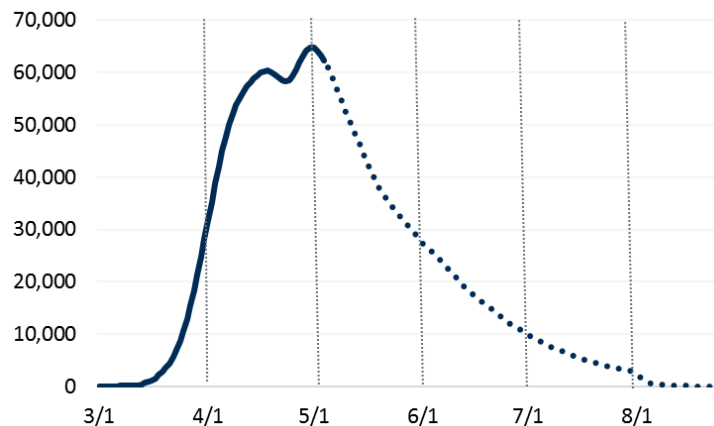
Economy-Wide Drop and Recovery?

Disease Outlook

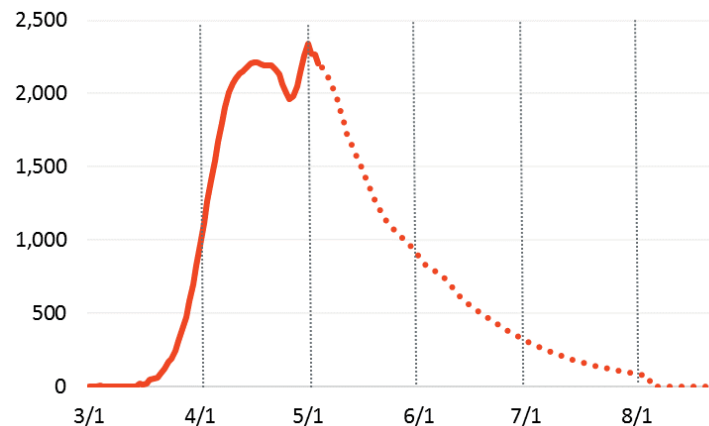
As of May 5, University of Washington IHME's model shows that peak realized hospital beds and deaths were lower in April than previously forecasted; however, *cumulative US deaths projected by August 4th have grown by 60% since their April 5 estimate, largely due to relaxed social distancing.*³

- Model shows U.S. peaking on May 1, both in terms of daily deaths and hospital beds needed.
- This IHME model is on the upper range of forecasted deaths by May 30.

Hospital Beds Needed for COVID-19 in U.S.
IHME Projection as of May 4th



Daily COVID-19 Related Deaths in U.S.
IHME Projection as of May 4th



IHME forecast for cumulative deaths by Aug 4:
Forecast as of April 5: **81.7K**
Forecast as of May 5 (shown above): **134K**

Forecasted Deaths for
May 30, 2020⁴

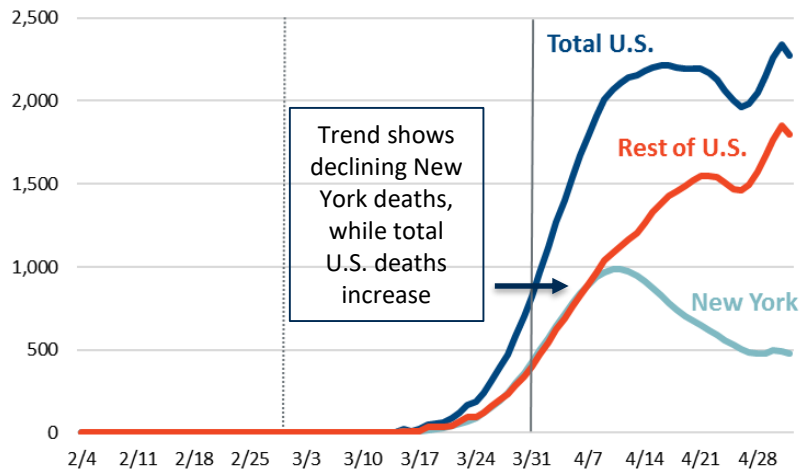
Model	Deaths (000s)
MIT	111
IHME	110
Los Alamos	107
Columbia Univ.	104
Northeastern Univ.	98
Univ. of Texas	93

Stabilizing or Still Growing?

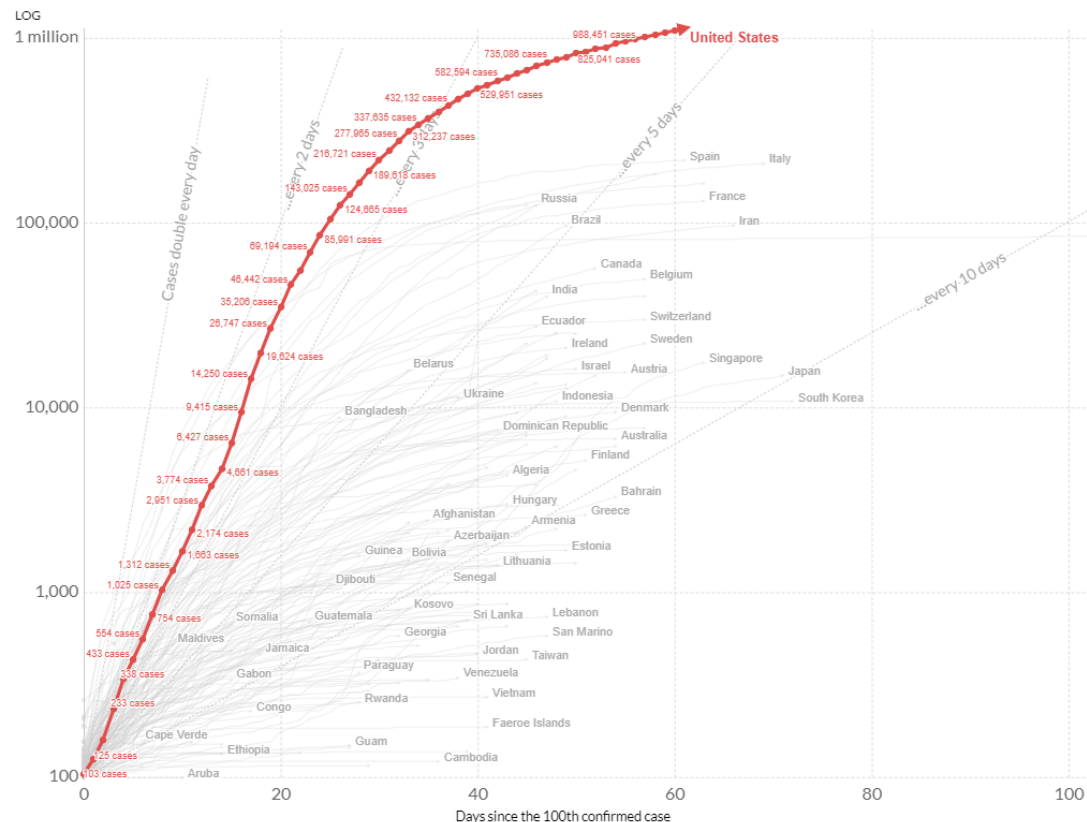
The U.S. death rate has been relatively flat in April, and our infections doubling rate has declined -- but is still higher than average on a global scale (~10-20 days).

- New York's share of total COVID-19 deaths has declined in April; at the beginning of the month, NY accounted for more than 50% of all U.S. deaths, but was less than 20% in early May.

Daily COVID-19 Related Deaths³



Growth Rates in Number of Confirmed COVID-19 Cases⁵



Economy-Wide Drop and Recovery? Macroeconomic Components

Outlooks for Q2 2020 continue to project a reduction in GDP as large as -37.9%, e.g., as forecasted by Morgan Stanley. There is mostly continued expectation of a quick recovery, with GDP rebounding and growing as much as +20% in Q3 2020.⁶

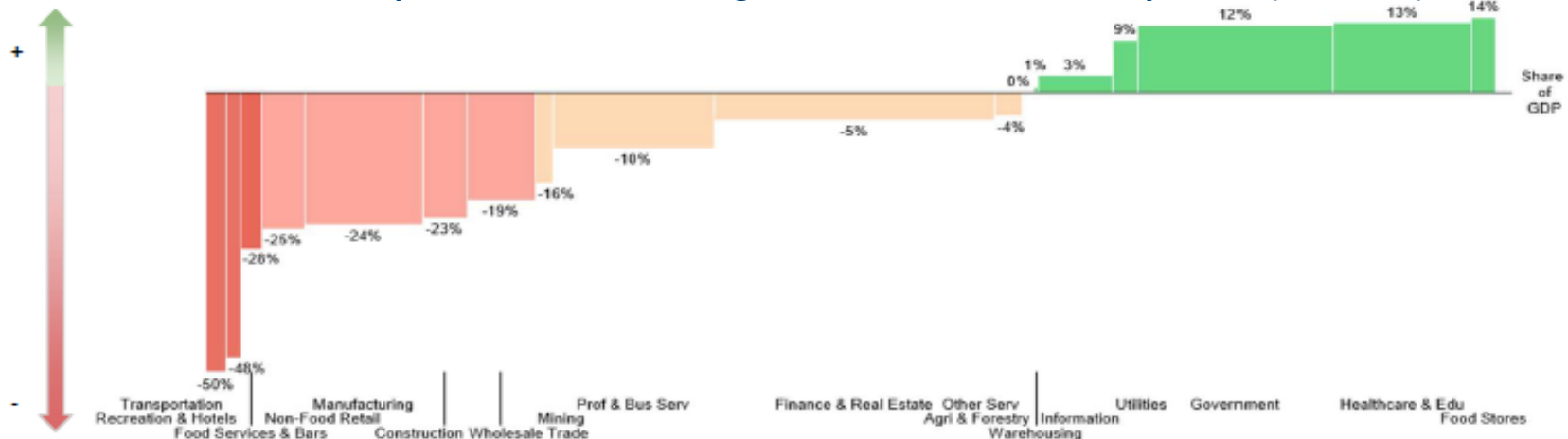
- This decline affects certain sectors much harder than others. A recent PWC April report suggested that some sectors, such as transportation & hotels and food services & bars, are experiencing reductions in revenues of as much as 50%.
- Reduction-weighted shares of GDP suggest about a 21% decline for Q2.

Illustrative Possible Q2 GDP Decline by Major Sectors^{7, 8}

Sector	2019 GDP	Assumed Q2 Decline	Implied Q2 GDP Loss
<i>Decreasing Sectors</i>			
Manufacturing	11.0%	-27.0%	-3.0%
Construction	4.1%	-40.0%	-1.7%
Retail	5.5%	-26.0%	-1.4%
Mining, incl. O&G	1.5%	-31.0%	-0.5%
Finance	7.6%	-9.0%	-0.7%
Health	7.6%	-42.0%	-3.2%
Utilities	1.6%	-7.0%	-0.1%
IT and comm'n	7.7%	-9.0%	-0.7%
Rest of Private Economy	41.2%	-30.0%	-12.4%
<i>Increasing Sectors</i>			
Fed & Local Governments	12.3%	+19.0%	+2.3%
Total			-21.2%

*Assumes 25% of the \$2Tr CARES package spent in Q2.

Potential Impact of Social Distancing on Q2 2020 GDP Growth by Sector (% of GDP)⁹



*Title and graph sourced from PwC April 27, 2020 report.

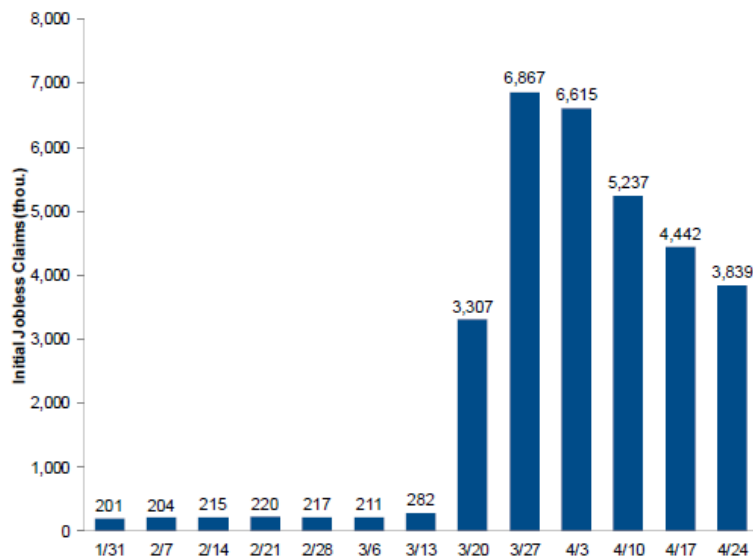
Economy-Wide Drop and Recovery?

Goldman Sachs (GS) May 3 report projects a larger realized drop in GDP in 2020 Q1 than reported by the Bureau of Economic Analysis, increasing from BEA's -4.8% to -7.7%. ¹⁰

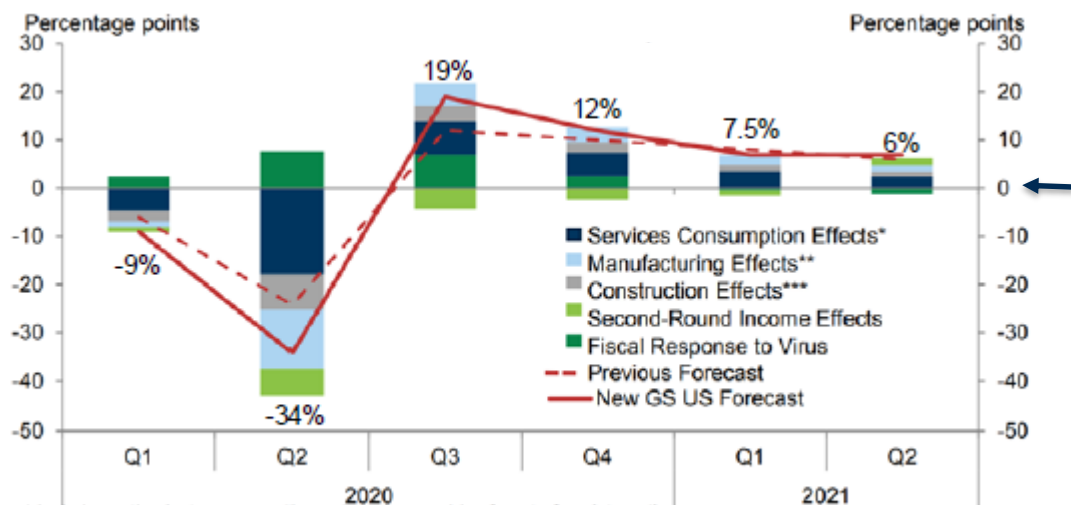
Dean & Company May 5 forecasts a total GDP reduction of -7.6% for all of 2020 (vs. -6% by GS) with a decline in corporate earnings of -19% and a potential stock price drop from February peak of -35-55%. ⁷

- Expecting that lagging infection control mitigations will have a greater negative impact on the economy and investor sentiment than the lockdown.
- Based on recovery patterns in prior economic shocks and estimated complexities of achieving large scale control and tracking of the virus.

U.S. Jobless Claims (Thousands) ¹⁰



Quarter-on-Quarter Change in US Real GDP ¹¹



* Includes cutbacks to consumption categories requiring face-to-face interaction

** Includes reduced domestic and foreign demand for goods, supply chain disruptions, and plant shutdowns.

*** Includes cutbacks to structures investment, homebuilding, and home sales.

3. Energy and Financial Sector Impacts

Oil & Refined Products – Spot prices

Oil prices fell 22-45% more in April as storage and oversupply concerns persisted, despite announced OPEC+ production cuts.¹²

WTI traded as low as **-\$40.32/bbl** on April 20 due to combined effects of May contract expiring and exhausted Cushing storage levels.

- Total US storage is ~81% full.¹³
- US storage 12% above five-year average for this time of year

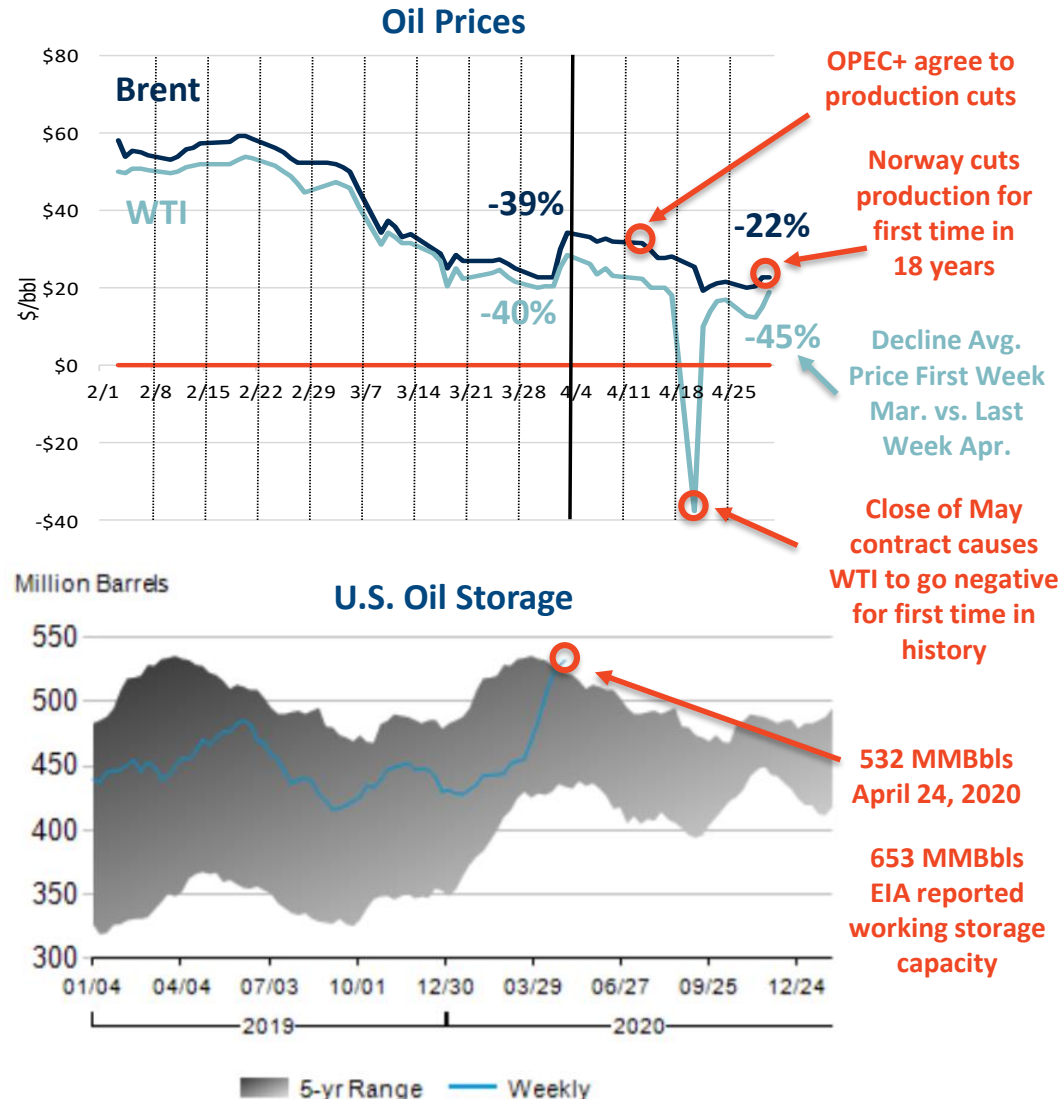
IEA estimates Q2 2020 world oil demand to be **23.1 million bpd** lower, full year 2020 demand to be **9.3 million bpd** lower.¹⁴

OPEC+ will cut production by **9.7 million bpd**, about **10% of global supply**, starting May 1.¹⁵

- But OPEC production was up 1.6 million bpd in April, reaching a 13-month high.

Other non-OPEC production cuts:

- U.S. – 900,000 bpd decline in April¹⁶
- Norway – 250,000 bpd in June and 134,000 bpd in 2H 2020.¹⁷



Oil Futures

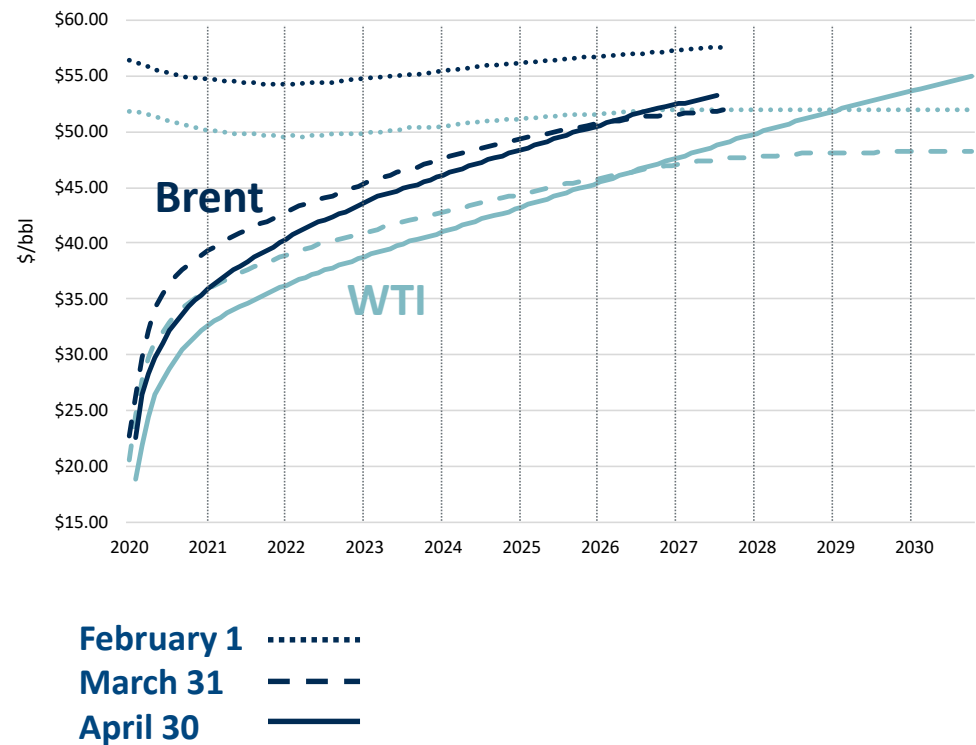
End of April oil futures curve is pricing in a longer recovery for oil markets than prior months—not reaching \$50/bbl until 2026-2028.

WTI and Brent futures for 2020-26 have dropped an additional 5% since the end of March:¹⁸

- Middle of the curve has dropped, reflecting longer disruptions to demand and production
- 2021 contracts have dropped on average 10%.

Later recovery is having dramatic financial effects in the oil industry:

- Shell cuts its dividend 66% - first time since World War II.¹⁹
- ExxonMobil reported first quarterly loss in 30 years.²⁰
- 12 largest oil majors have cut their 2020 capex programs by over \$40 billion.²¹
- Approximately 100 energy companies have been downgraded by S&P Global Ratings due to lower oil prices.²²
- At least 4 oil and gas producers have filed for bankruptcy since March.^{23,24}



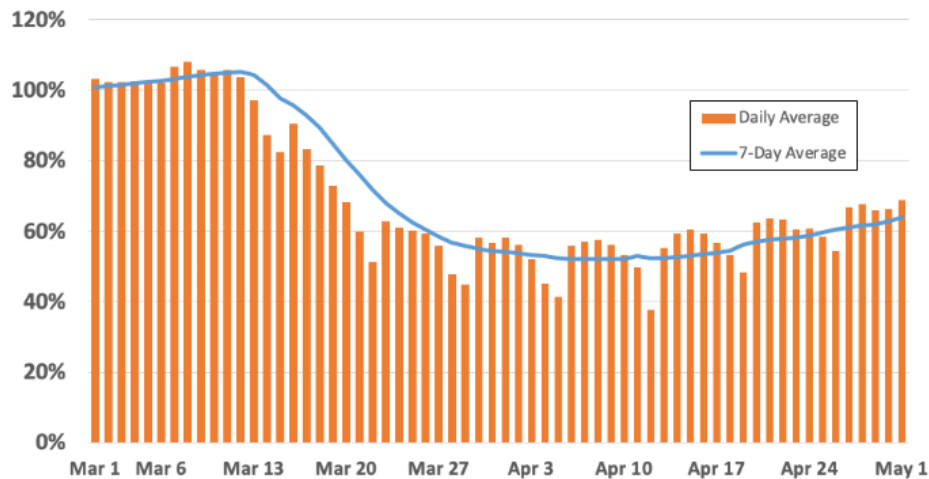
Source: S&P Market Intelligence, as of May 1, 2020.

Gasoline Prices and EVs

Wholesale and retail gasoline have continued to decline by \$0.15 and \$0.23 per gallon, respectively; new EV model development is delayed due to COVID-19.

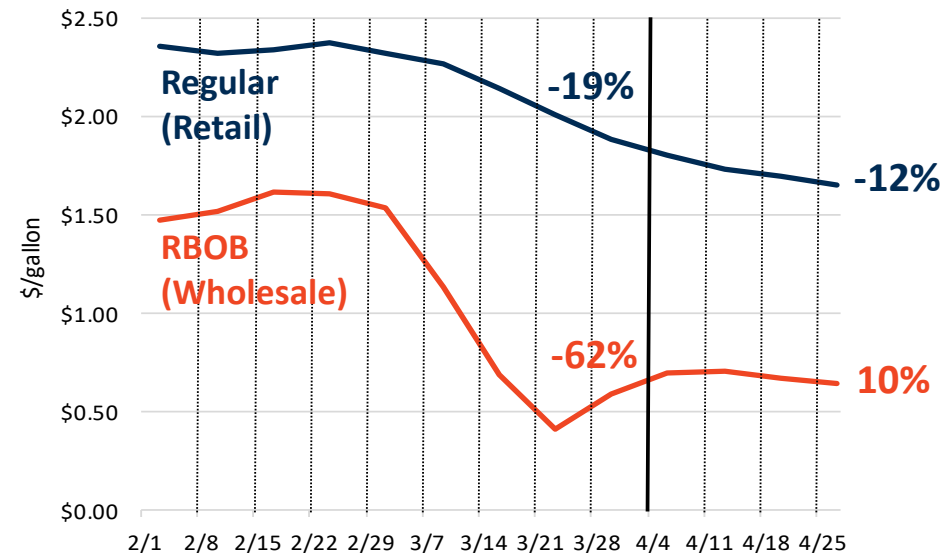
- Personal vehicle travel is recovering from a maximum decrease of ~45% to now down ~36%.²⁵
- General Motors, Ford, and Rivian have delayed rollout of new EV models; Lincoln (Ford) and Rivian cancelled joint-development project citing “current environment.”²⁶

Relative Level of Passenger Vehicle Travel²⁵



Source: INRIX, accessed May 4, 2020.

Retail US Gasoline^{12,27}



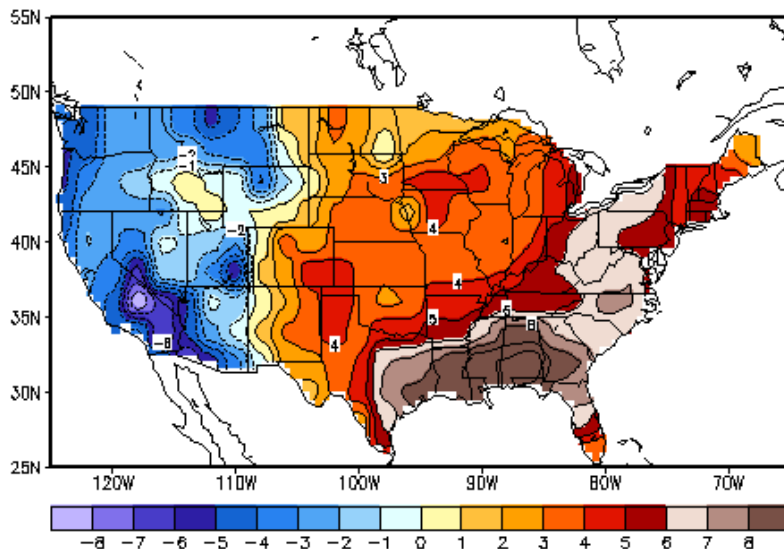
Source: U.S. EIA and S&P Global Market Intelligence, as of May 1, 2020.

Weather

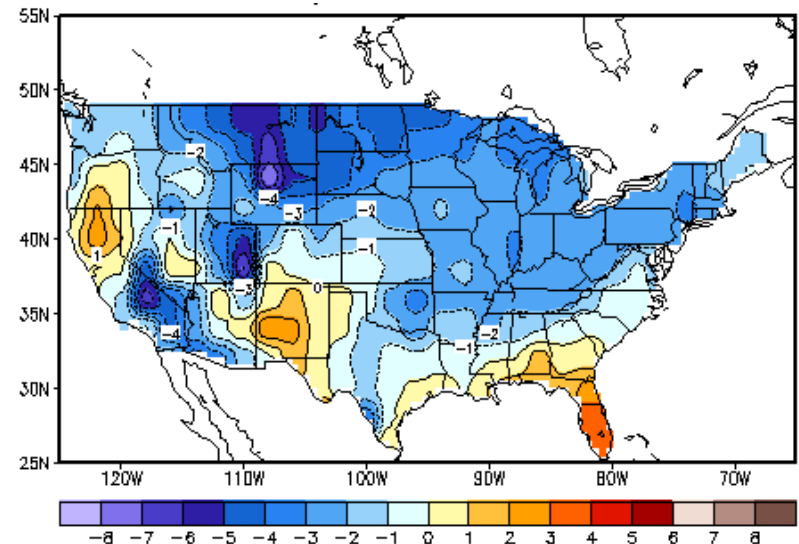
April weather was colder than normal across much of the U.S., likely pushing natural gas demand and prices slightly higher.

Deviation between Average Actual and Normal (°F)²⁸

March 2020



April 2020



Natural Gas – Demand

Recent changes in residential and commercial gas use appear to be driven by weather and less so by COVID-19 effects.

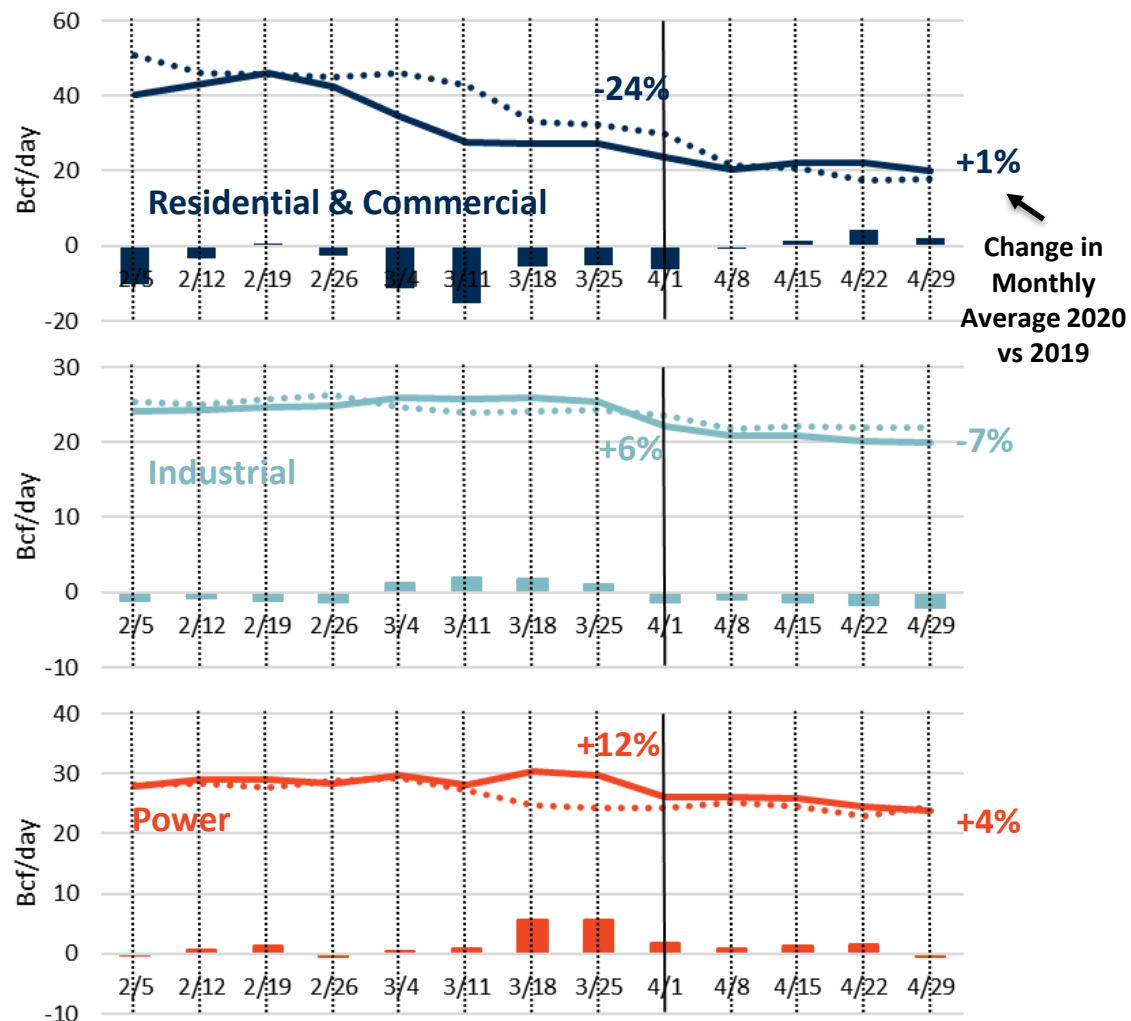
- Lower demand started prior to mid-to-late March when social distancing measures took effect.

Average industrial gas demand decreased 7% in April 2020 vs April 2019 as industrial heavy states imposed stay at home orders; impacts increased as the month progressed:

- 4/8: -4%
- 4/15: -6%
- 4/22: -8%
- 4/29: -9%

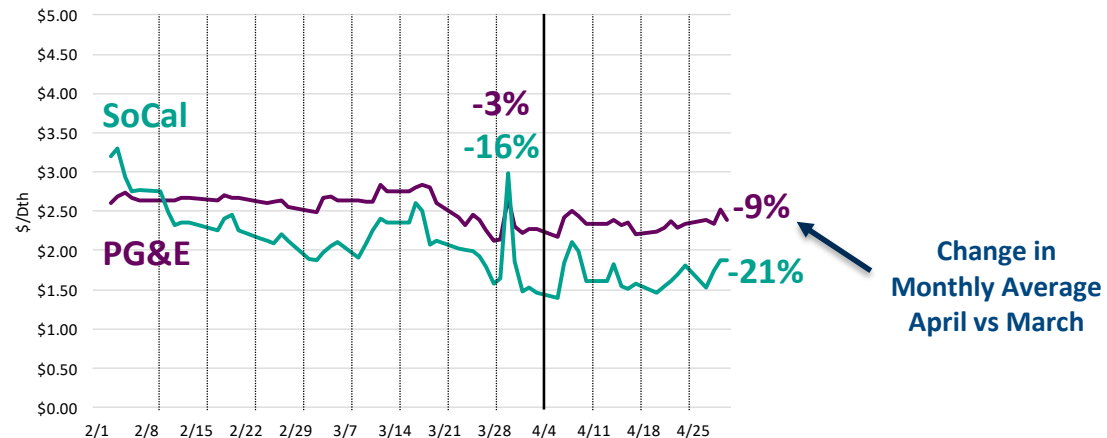
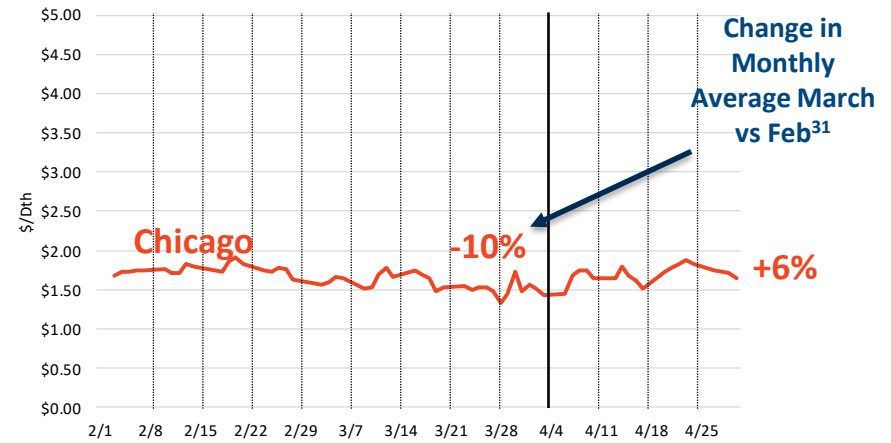
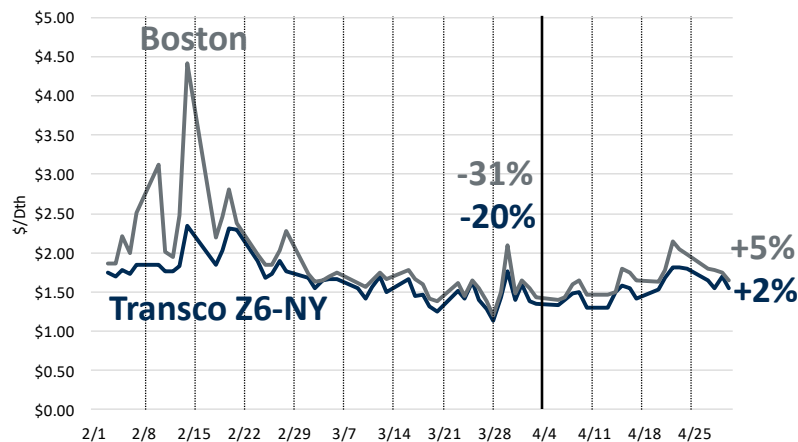
Natural gas demand for power is 4% higher than April 2019, partly due to 8.3 GW of natural gas capacity additions in 2019. However, April generation is down about 14% from March of this year.²⁹

Natural Gas Demand – 2020 vs. 2019³⁰



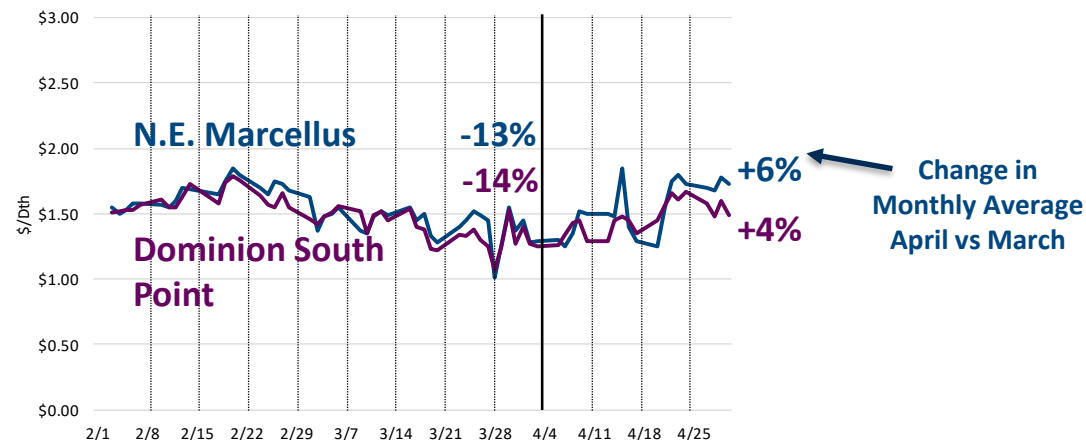
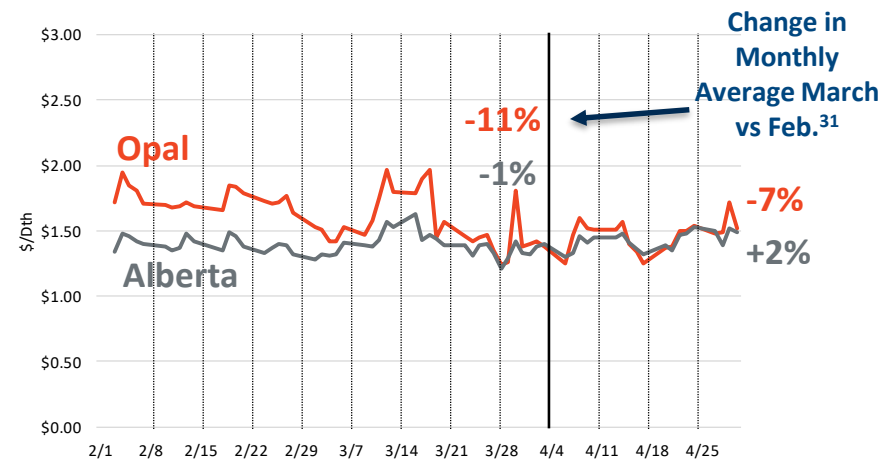
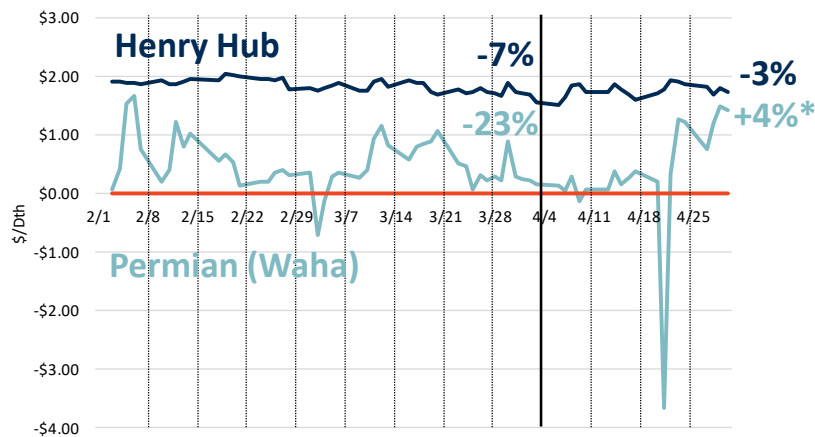
Natural Gas Spot Prices – Demand Regions

Gas spot prices in Northeast and Midwestern markets increased in April over March due to colder weather, whereas April California prices remained lower.



Natural Gas Spot Prices in Supply Regions

Permian prices went negative (mirroring WTI); dry gas prices have strengthened reflecting lower associated gas production.



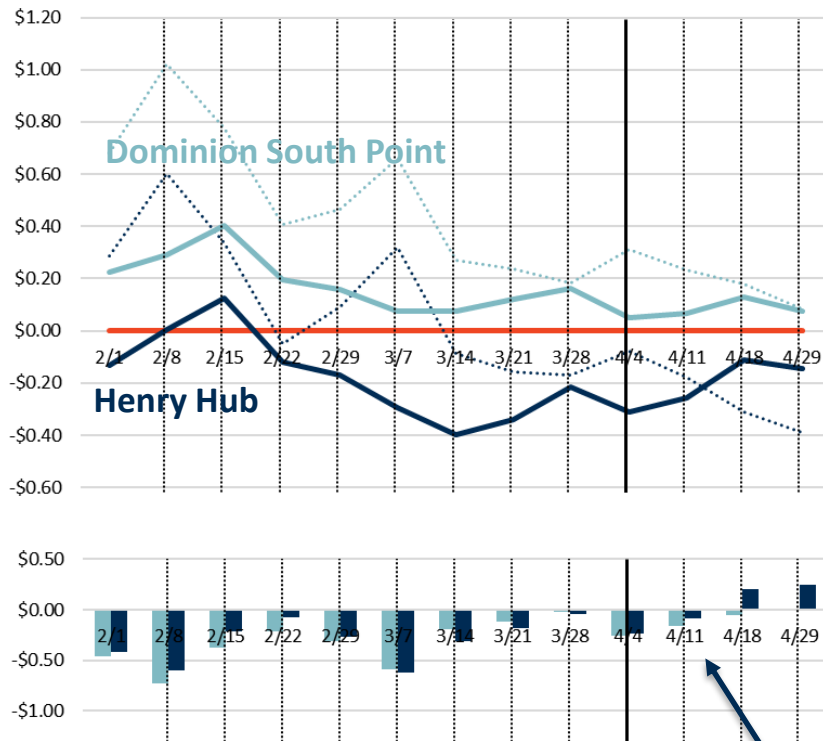
*+4% excludes negative spike on 4/21/2020
-37% if negative spike is included

Source: S&P Market Intelligence, as of May 1, 2020.

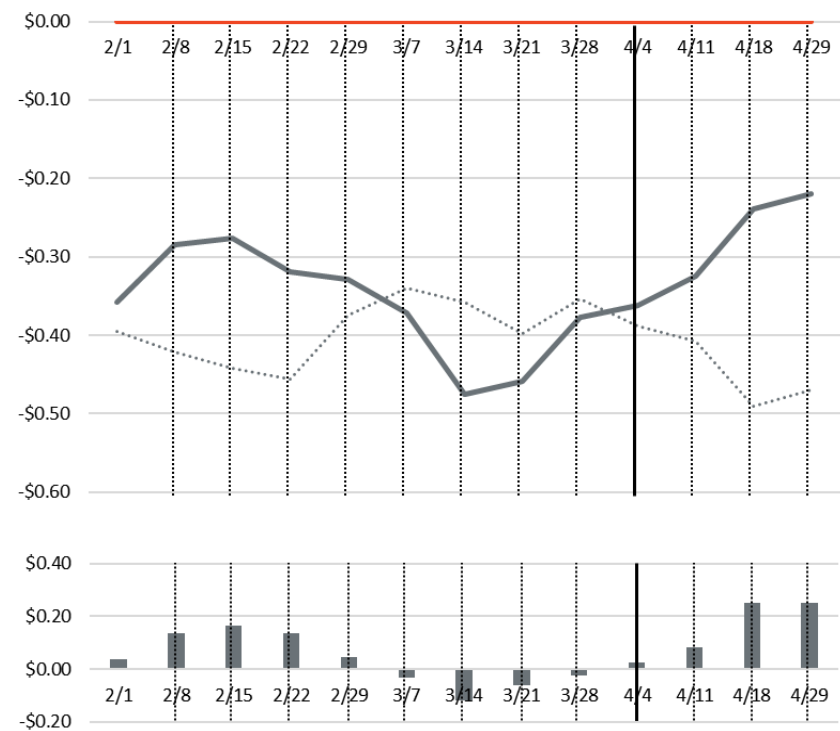
Natural Gas – Weekly Basis Differentials

Strengthening dry gas prices are causing northeast basis differentials to flatten.

To New York City³¹



Henry Hub to Dominion South Point³¹



Spreads Calculated as: Destination - Origin

Difference from
4 Year Average

Natural Gas – Summer/Winter Spreads

Henry Hub forwards are higher across the curve; summer/winter 2020 have widened to \$1.17/Dth (from \$0.63 on Feb.1), creating strong incentives for storage injections.

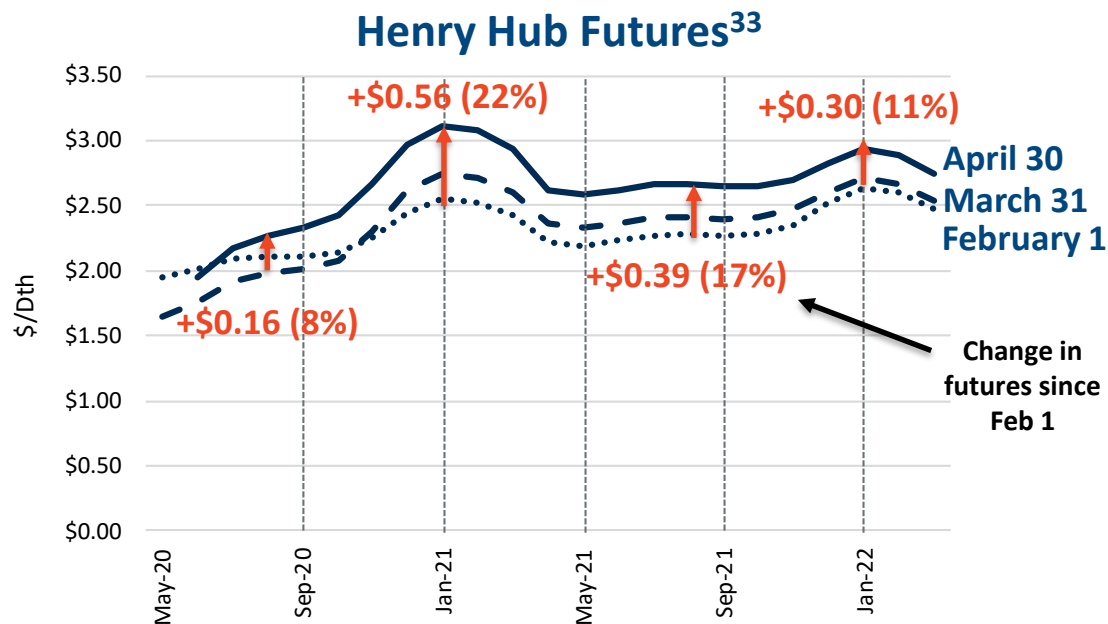
Forward curve has also shifted higher by about \$.30 since the end of March, reflecting lower associated gas production for longer.

August natural gas prices increased 8-17% which could push summer power prices higher.

Summer/Winter 2021 spread is lower (down \$0.09/Dth) driven by \$0.40 increase in summer 2021 gas prices

- Spread much smaller than Summer/Winter 2020 (\$0.32 vs. \$1.17)
- Absolute gas prices are \$0.30-\$0.40 higher than in Feb, indicating longer supply disruptions

Speculative investors are net long 15k contracts at the end of April versus net short 330k contracts in February (largest net short position on record)—a rapid shift to a bullish view on gas prices due to decreasing associated gas production.³²



Natural Gas – LNG

Lower global demand for natural gas due to the economic shutdowns has resulted in cancelled US LNG cargoes.

Global LNG demand is expected to fall by 11 million tons/year (480 Bcf/year) in 2020 due to the economic downturn.³⁵

Record low Asian and European gas prices have created challenging environment for US sourced LNG.³⁶

- Netback to Asia \$1.046 (-\$0.84 margin*)
- Netback to Europe \$1.216 (-\$0.67 margin*)
- Sempra delayed FID on Port Arthur LNG until 2021 citing COVID-19 impacts on energy markets³⁷

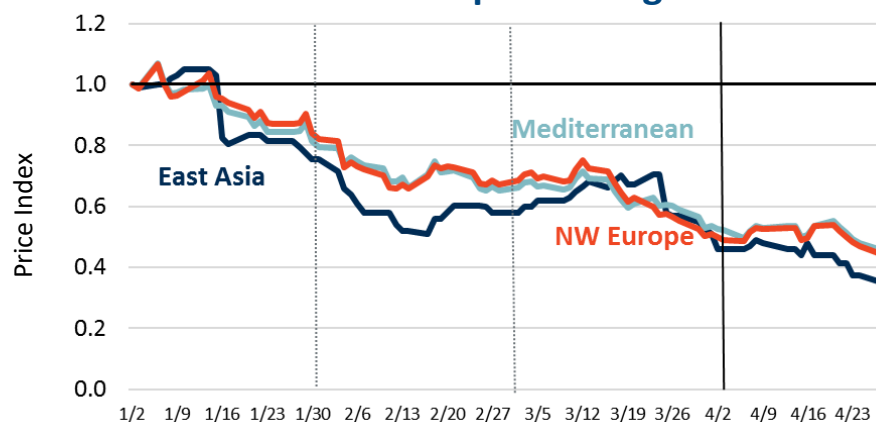
Approximately 25 LNG cargoes from the US have been cancelled for June.³⁸

- Estimated total volume of 80 Bcf.
- US exported 47 cargoes in June 2019.³⁹

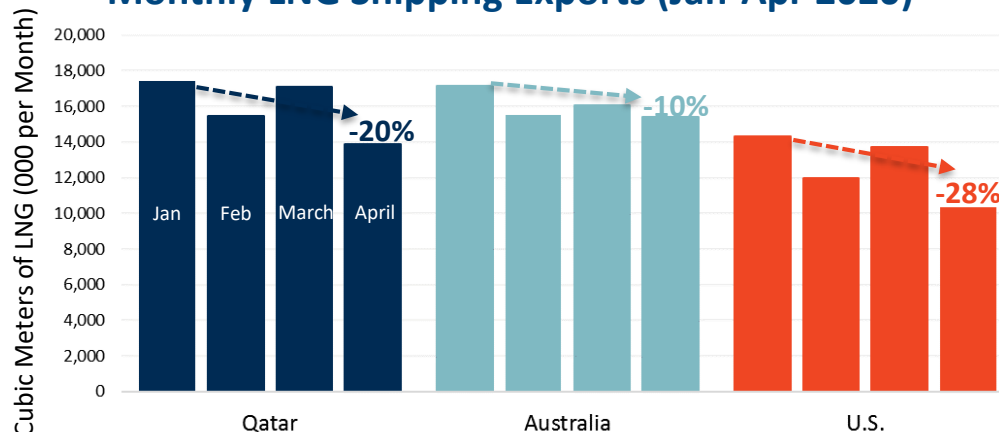
Cancelled LNG volumes will be offset by associated gas shut-ins.

- Goldman Sachs estimates associated gas shut-ins of approximately 4.6 Bcf/day.⁴⁰
- 80 Bcf spread evenly over June is ~2.7 Bcf/day.
- Cancelled cargoes equivalent to ~4% of total June 2019 demand.⁴¹

LNG Spot Pricing³⁴



Monthly LNG Shipping Exports (Jan-Apr 2020)³⁴



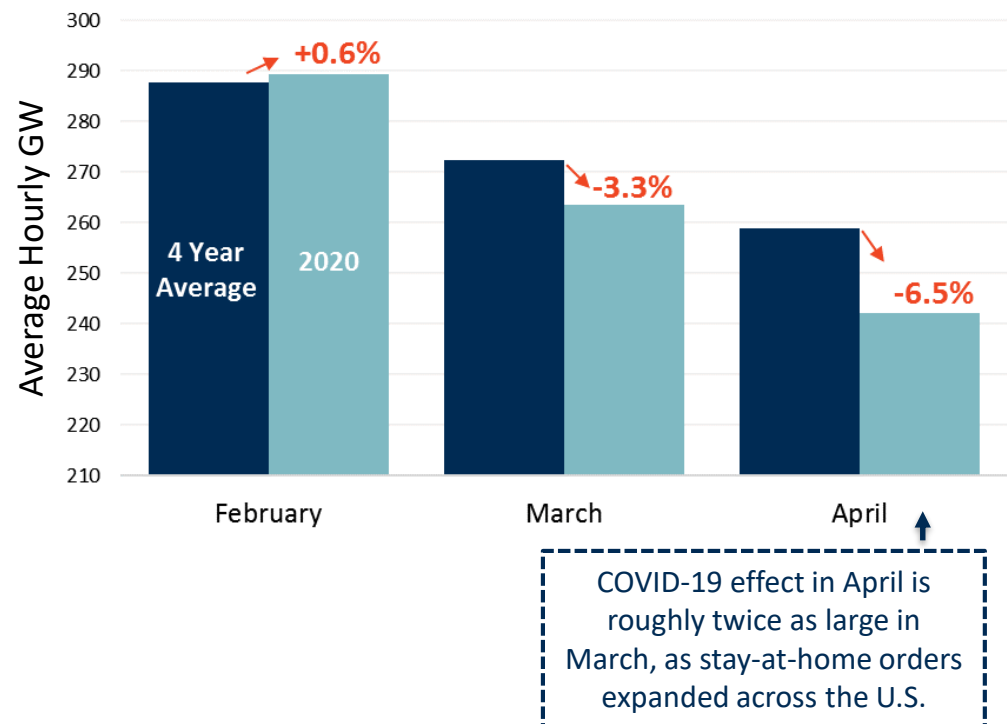
*As of May 1, 2020

Impact on Regional Electric Loads

April 2020 average hourly load for seven major ISOs* dropped 6.5% in April compared to the past four years, nearly double the 3.3% reduction in March.

- This 6.5% reduction may be about as deep as the load reductions from social distancing and COVID-19 will reach, *barring bankruptcies and other economic fallout*:
 - C&I bankruptcies would further decrease C&I load, if companies were to shut down
 - Personal bankruptcies and increased “bad debt” could impact rate collections
- Residential load has increased by **6-8%** during this time period, suggesting that the load decline shown overall is driven by the approximately **14.5-16%** decline in C&I load.⁴³

7 ISOs' Electricity Load* in February-April 2020 Relative to Load for Prior 4 Years (2016-2019)⁴²



*CAISO, MISO, ISO-NE, NYISO, PJM, ERCOT and SPP; collectively these ISOs represented approximately 55% of total U.S. load in February through April 2019.^{44, 45}

ISO Comments on COVID-19 Impacts

Similar to March, all of the 7 ISOs reported have reported load reductions in April, ranging from 3-15%.

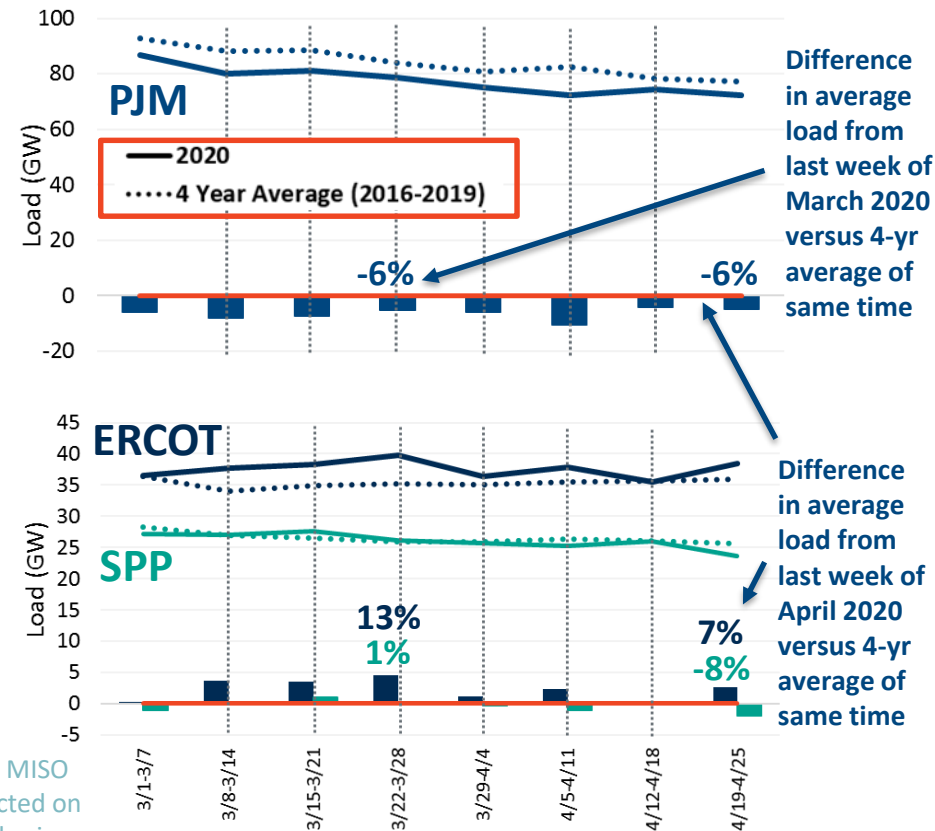
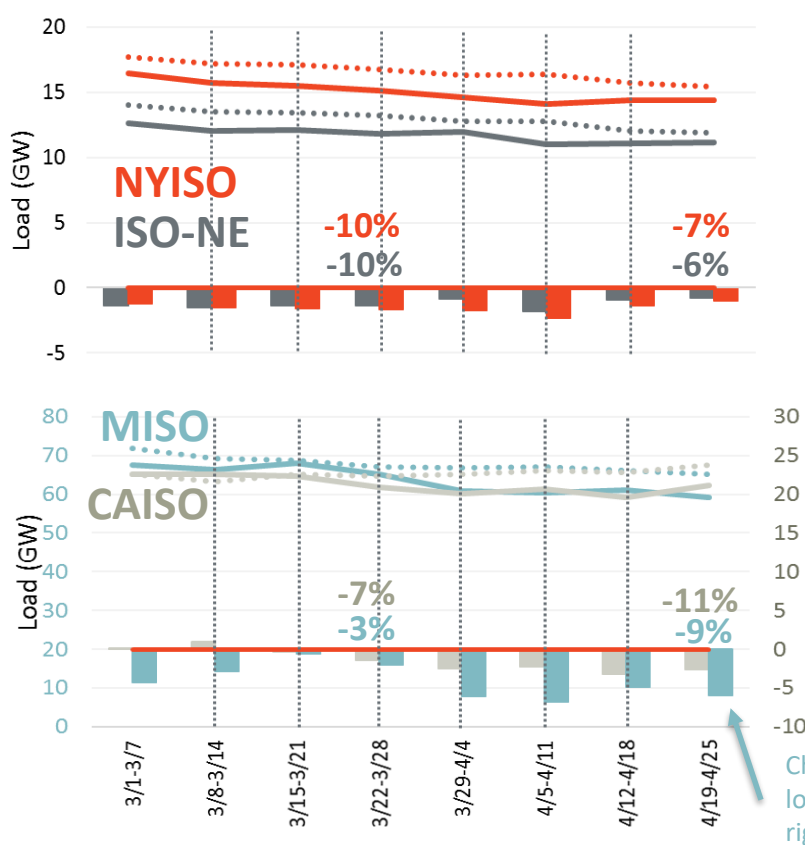
Estimates of Load Reduction due to COVID-19^{46,47,48,49,50,51,52,53,54}

PJM	PJM reports: total daily energy use down 7%, weekday peak down 8-10%, weekend load down 2-4%, peaks smoother compared to traditional seasonal hourly loads.
CAISO	CAISO reports: weekday load reduction down by 4.5%, weekend load reduction by 0.5%. Energy prices lowered by \$9 in real-time market and \$8 in day-ahead market
ERCOT	ERCOT reports: weekly energy use down 4-5%, daily peaks down 2-5%. However, with the rising summer temperature, load might increase in the coming months.
MISO	MISO reports: load reduction of 4.75%, morning peaks shifted to later in the day, energy use higher in the afternoon
ISO-NE	ISO-NE reports: load demand down 3-5%, days resemble snow days, with slower morning ramp up and increased afternoon consumption.
NYISO	NYISO reports: in April, hourly electric consumption down 3-15%, peaks averaged 7-8% below expected. Reduction in electricity driven by commercial demand decline but residential consumption is up.
SPP	SPP reports a 4-6% reduction in load during the beginning half of April. There have also been increases in cancellation of planned generation and transmission outages.
New York City	NYISO reports: in New York City, electricity consumption down 2-18%. Reduction during morning ramping period is most pronounced in NYC and on Long Island. Demand reduction, as high as 18% has been observed in these regions during the 7 to 9 AM ramping period.
U.S. Overall	According to World Economic Forum, energy usage has hit a 16-year low for the week of April 4. EIA predicts 3% decrease in energy sales -4.7% for commercial sales -4.2% for industrial sales -0.8% for residential sales EIA and NYT predict renewable power generation will increase (+11%), which is lower than previous growth estimates

Impact on Regional Electric Loads

The US ISOs have shown roughly similar % load losses in April likely due to COVID-19, though ERCOT continues to show an absolute increase in load due to overall market growth.

Weekly Average Hourly Load: March-April⁴²

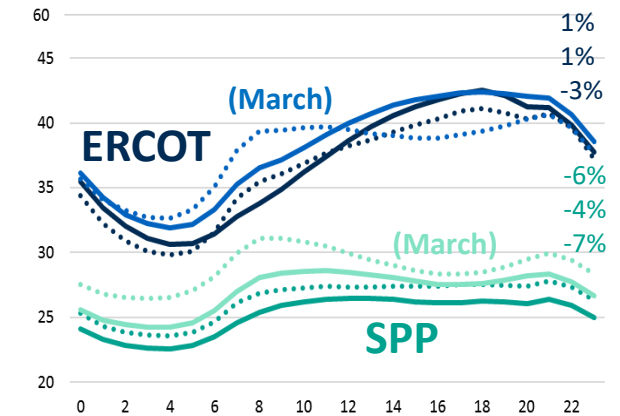
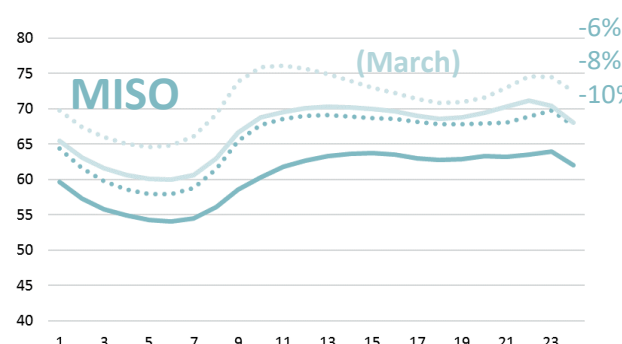
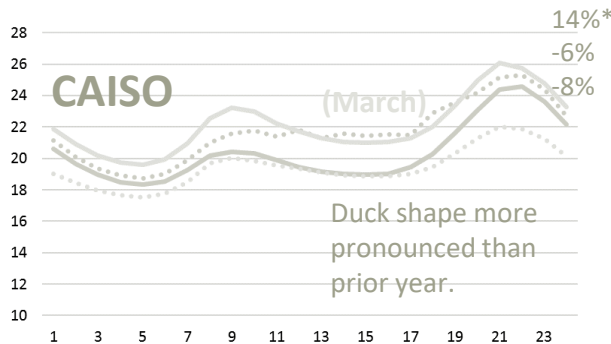
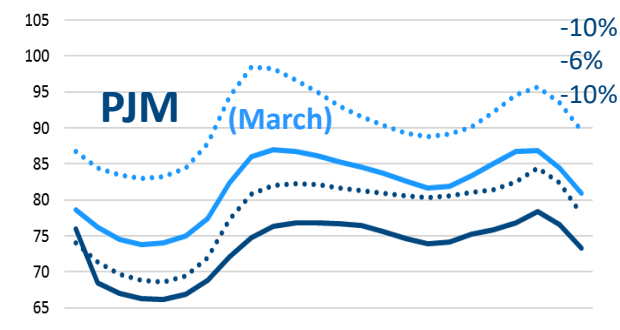
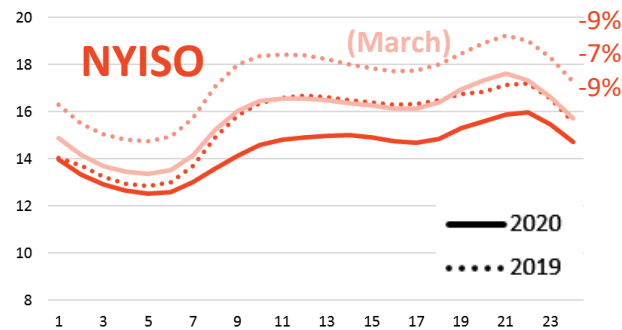
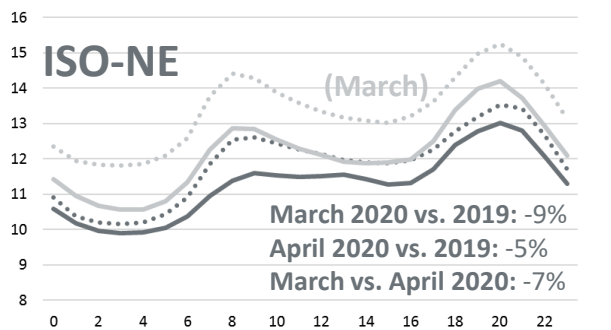


Note: Most demand reductions likely fall in peak hours, which accounts for approximately 50% of hours and the majority of energy consumption, so the impact on peak hours is likely greater than the all-hours estimated decreases above.

Impact on Regional Electric Load Shapes

- Qualitatively, the load shapes across ISOs have remained largely unchanged, except for CAISO and ERCOT which have higher late afternoon peaks in 2020 than 2019.
- Except ERCOT, all of the ISOs have lower load levels in April 2020 versus April 2019.

Daily Average Load Shapes For March and April (GWh)⁴²

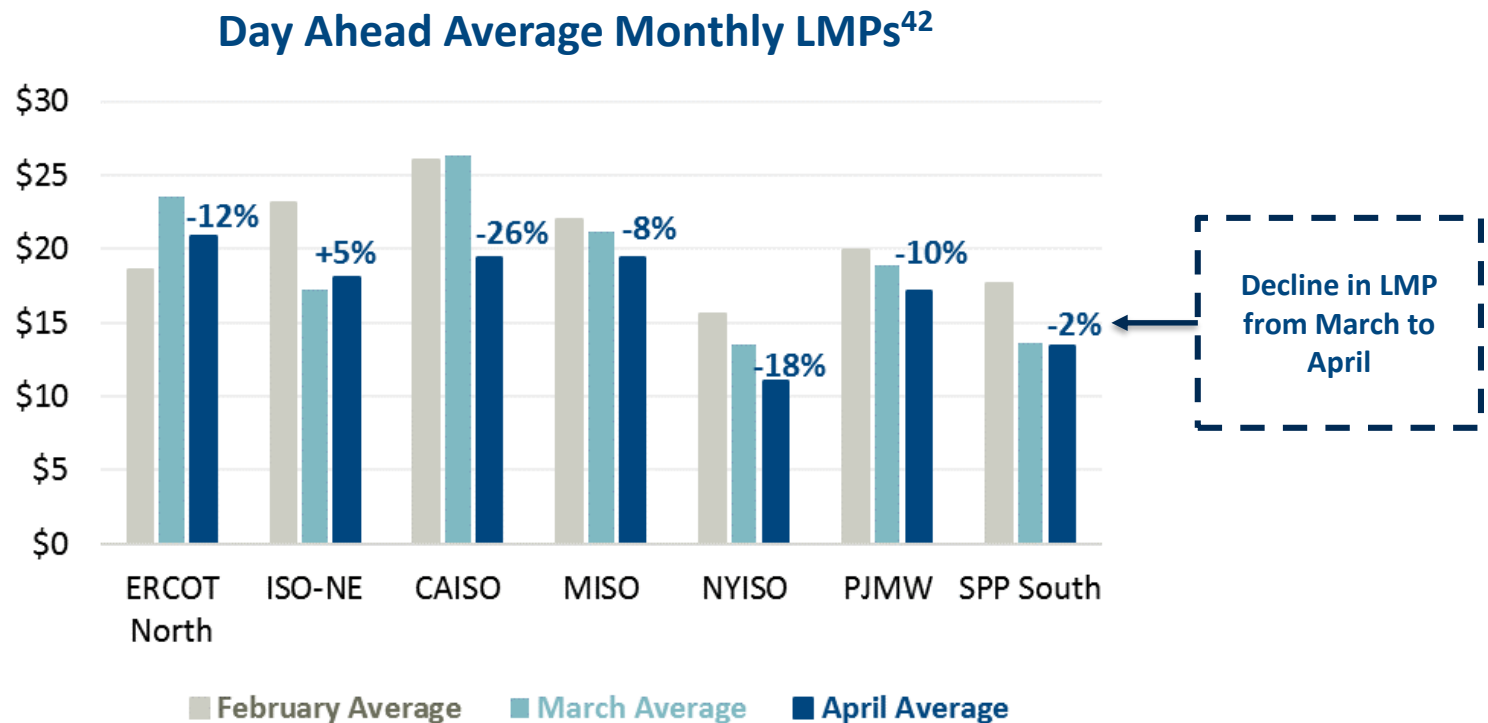


Note: March 2019 load was 17% lower than the average of 2016-2018 in CAISO.

Impact on Spot Electricity Pricing

Daily LMPs have fallen since March across several ISOs, shown below (not normalized: partly weather, partly COVID-19 due to load and fuel price reductions).

- Regardless of cause, this will strain viability for some coal and nuclear plants



Note: ERCOT North data reflects settlement point prices.

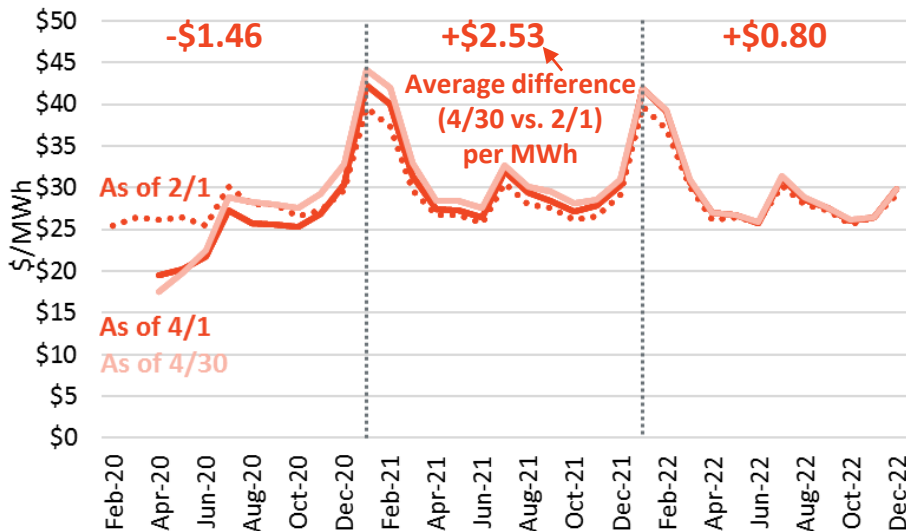
Power Price Forwards in Last 3 Months

At ISO hubs, average on-peak forward prices for rest of 2020 dropped between \$2.40-\$4.50/MWh from February to April, but have not systematically fallen for 2021 and beyond;

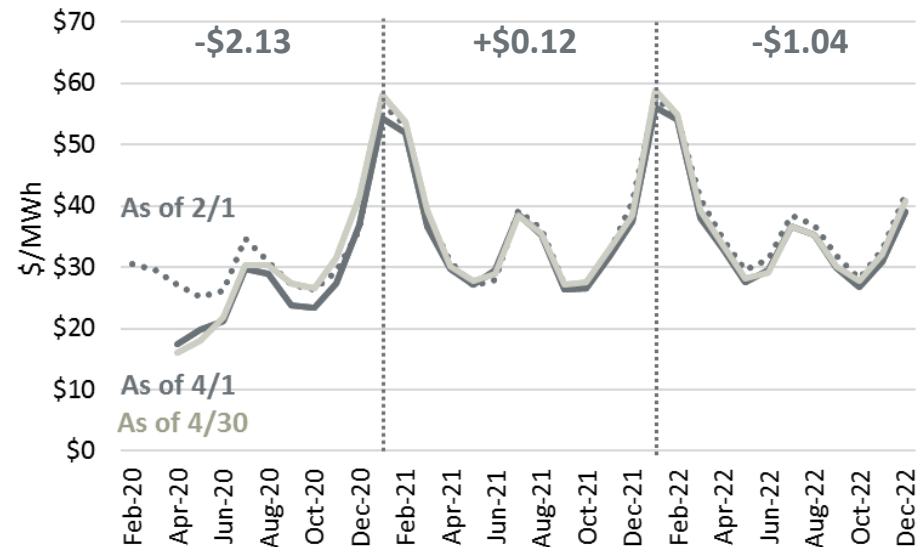
- No significant variation within April (suggesting fuel and load expectations have stabilized).

On-Peak Power Price Forwards (February 2020-2025)⁵⁵

PJM West



NY-ISO- Zone J

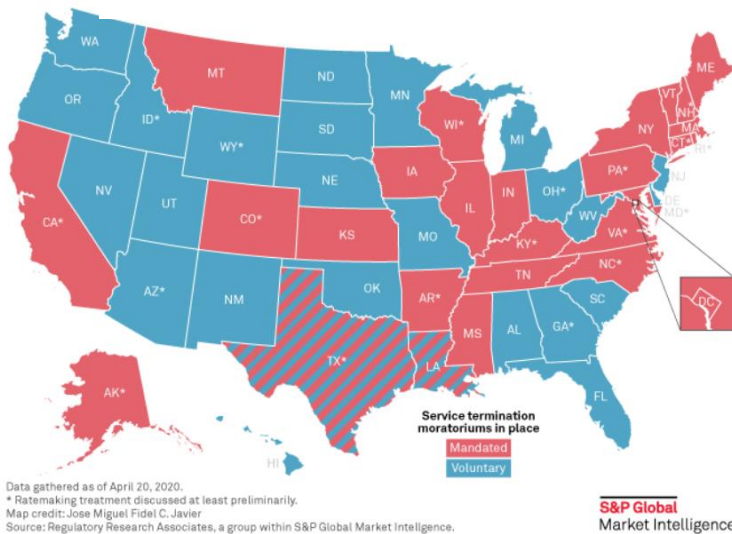


State Regulations Protecting Customers

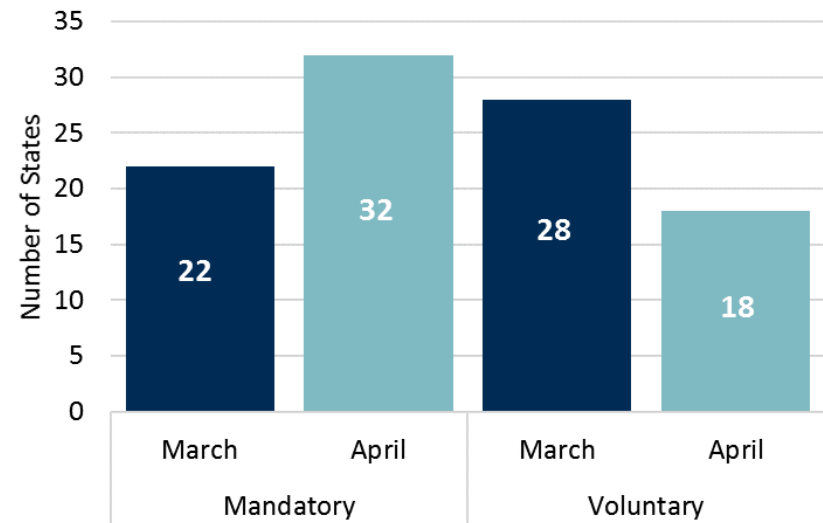
All states have mandatory or voluntary suspensions of utility shutoffs as of late April, with 10 more becoming mandatory in April compared to March.

Utility Shutoff Regulations in Response to COVID-19

Service Termination Moratoriums⁵⁶



Service Termination Moratoriums⁵⁷



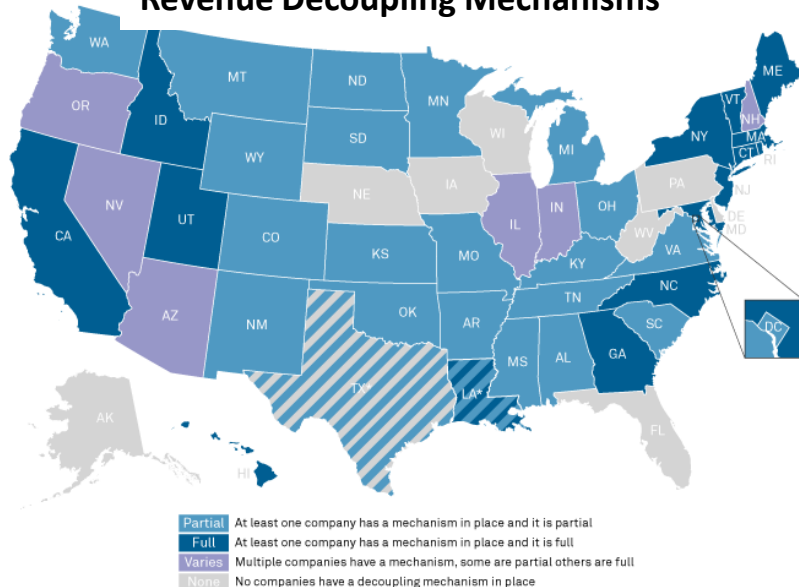
Utility Decoupling Mechanisms vs. Unemployment

Many utilities are putting their hopes of revenue stability on decoupling, but it may become stressed under COVID-19:

- Of the 8 states with no decoupling, 6 have higher than average unemployment rates.^{56,58}
- Conversely, of the 14 states with full decoupling, 9 have below average unemployment.^{56,58}

Utility Decoupling Mechanisms vs. Initial Unemployment Claims

Revenue Decoupling Mechanisms⁵⁶



As of March 31, 2020.

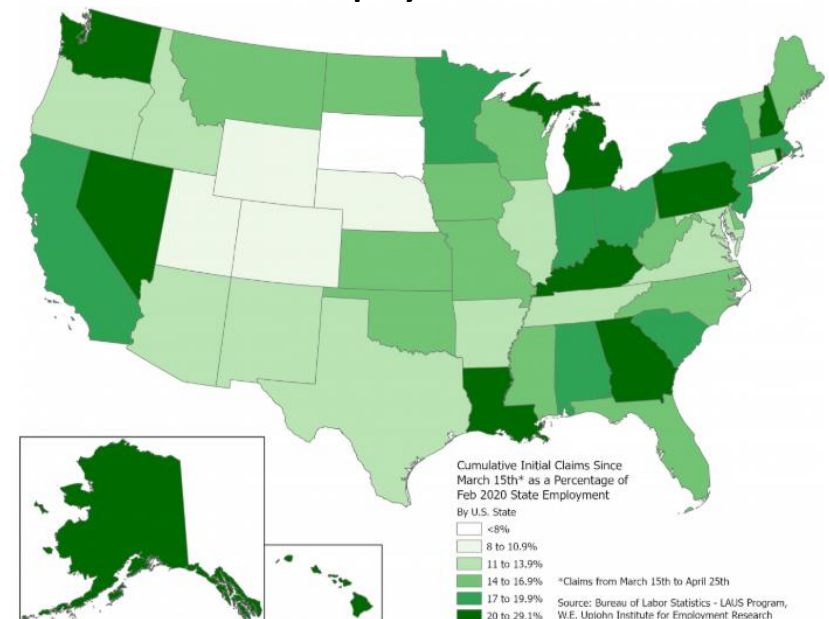
* In Louisiana and Texas, there are two different regulatory commissions, with differing policies.

Map credit: Jose Miguel Fidel C. Javier

Source: Regulatory Research Associates, a group within S&P Global Market Intelligence

S&P Global
Market Intelligence

Cumulative Initial Unemployment Claims since March 15⁵⁹



Regulatory Responses to COVID-19

Twenty-two states have passed or are in the process of passing regulations to support utilities' recovery of COVID-19 related costs.⁵²

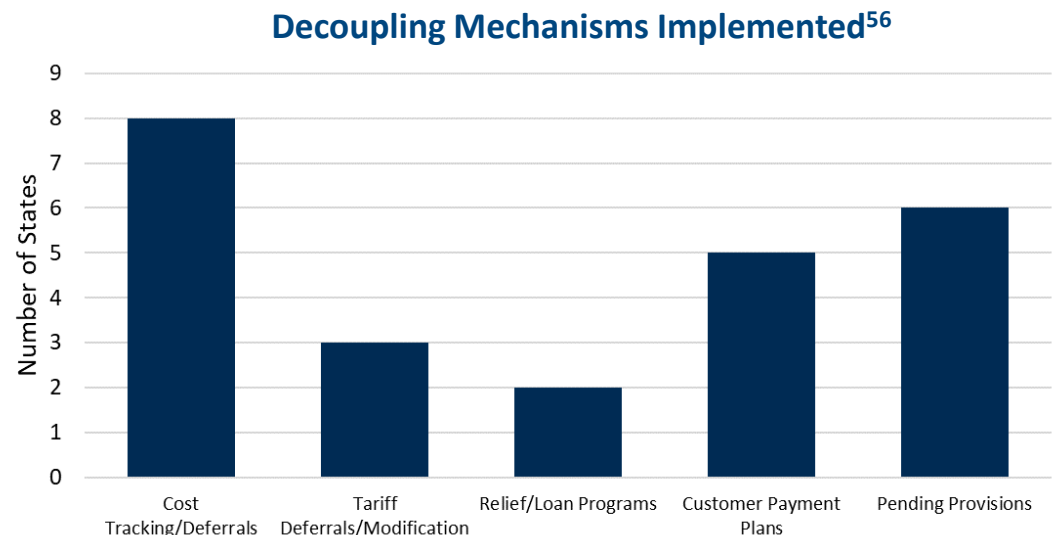
Regulatory assets to track or defer costs are the most common cost recovery provision passed by states, so far.

- Future proceedings will consider utility's request to recover these assets.

Five states have clarified that customers are expected to fully repay their bill once the moratorium is lifted.

- Customers can set up payment plans to repay the full amount owed.

Texas has established a regulatory mechanism for retail electric providers to recover a reasonable portion of cost related to shutoff moratorium.



Electric Cooperatives

Electric cooperatives are experiencing load and revenue reductions attributable to COVID-19, which are amplified by cooperatives' rural service territories and unique financing structures.

Electric cooperatives' loads are expected to decrease by 5% in 2020, which equates to a \$7.4 billion impact to revenues.⁶⁰

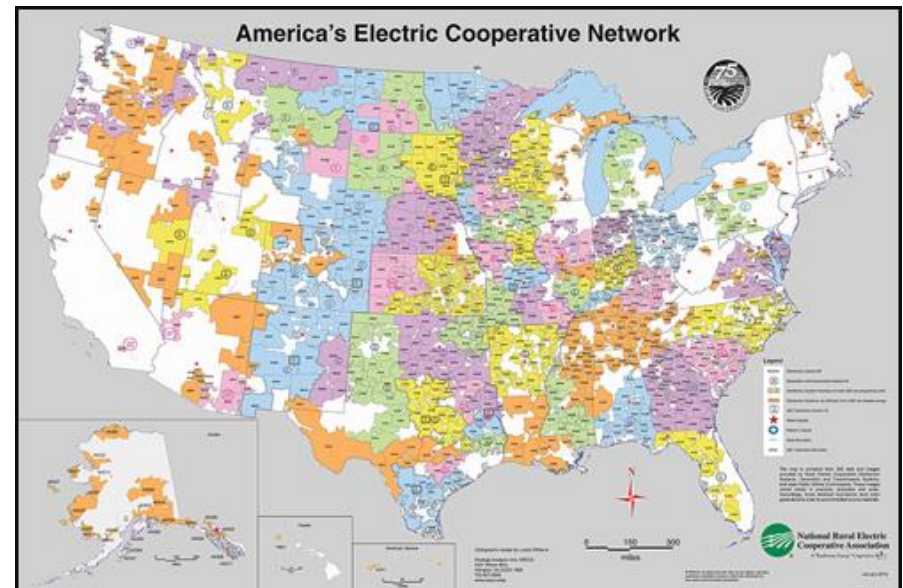
NRECA estimates bill delinquency rates to reach 4% in 2020 and unpaid bills to increase to \$2.6 billion through 2022.

- Cooperatives serve rural communities which are particularly vulnerable to economic downturns.
- Approximately 13% of customers are in at-risk sectors of the economy.

Cooperatives financing structure may limit their financial cushion to absorb economic impacts.⁶¹

- Debt financing is typically secured through the USDA's Rural Utilities Service (RUS) loans.
 - Elec. cooperatives hold >\$40 billion in RUS loans
- Equity is raised from coop members and excess is typically returned to members.

Cooperatives are seeking congressional action to allow refinancing of RUS loans without penalty.



Note: NRECA⁶²

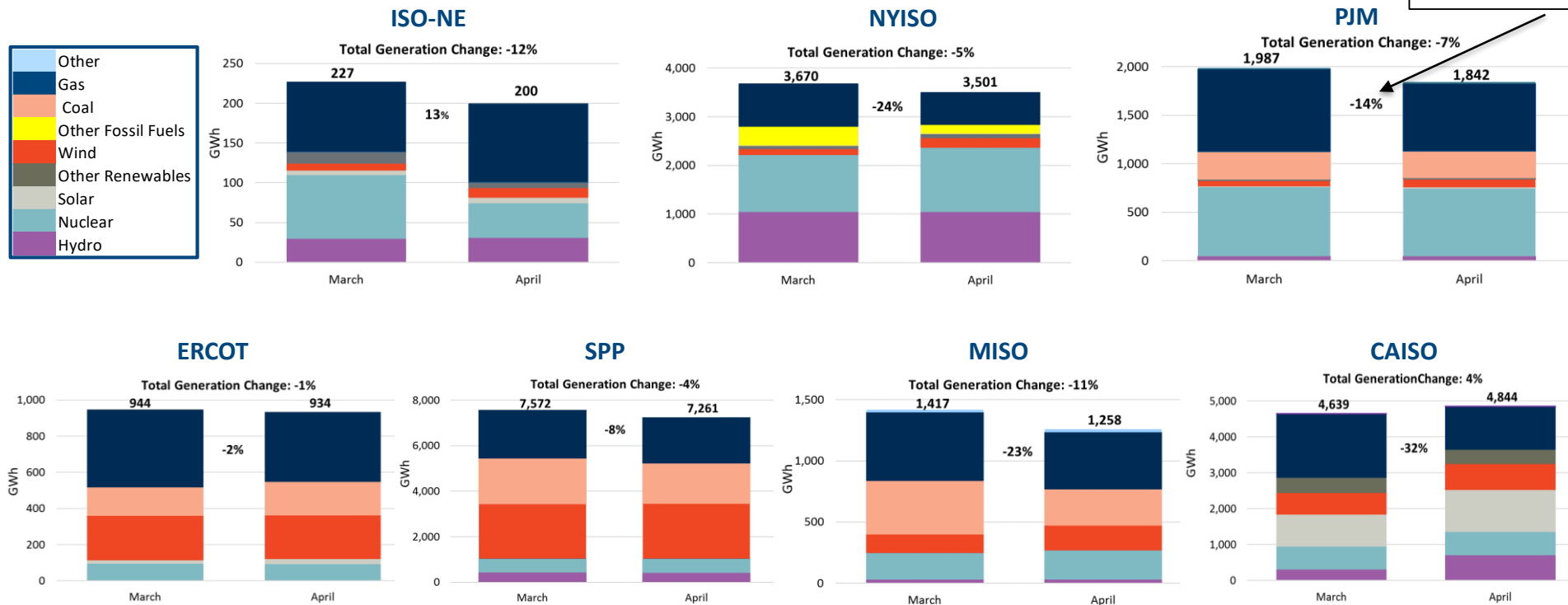
- States served by electric cooperatives are now seeing an increase in COVID-19 cases.
- Electric cooperatives make up about 14% of total US electric sales.⁶³
- Coal is 40% of generation for electric cooperatives.⁶⁴

Generation Impacts

EIA projects COVID-19 impacts on electricity will cause a 4.9 GW delay or cancellation of previously planned capacity expansions through September 2020.⁶⁵

- Generation has decreased in all ISOs except CAISO due to seasonal and COVID-19 effects.
- But reduced generation has mostly fallen to a greater extent on natural gas and coal plants.

Generation by Fuel Type (GWh)^{66,67,68,69,70,71,72}



Renewable Energy Short Term Needs & Usage

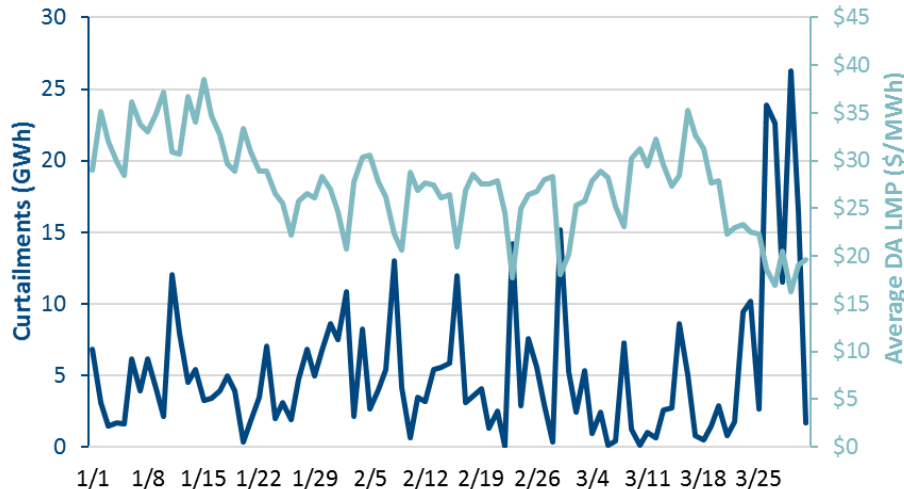
In most parts of the country, there is little to no decline in renewable energy usage.

- Notwithstanding MWh of solar and wind curtailments that have nearly doubled in 2020 relative to 2019 in CAISO – because total renewable generation is also up in April compared to March 2020

Declining fossil generation and lower total load mean less demand for RECs by the end of the year.

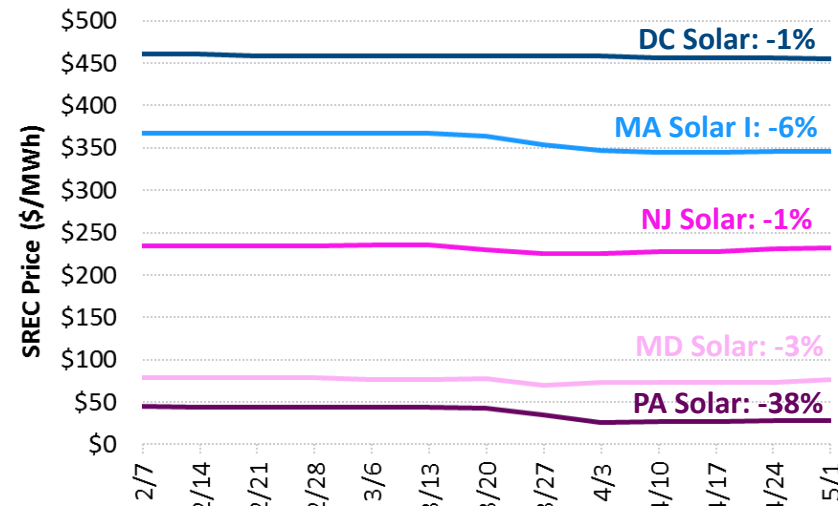
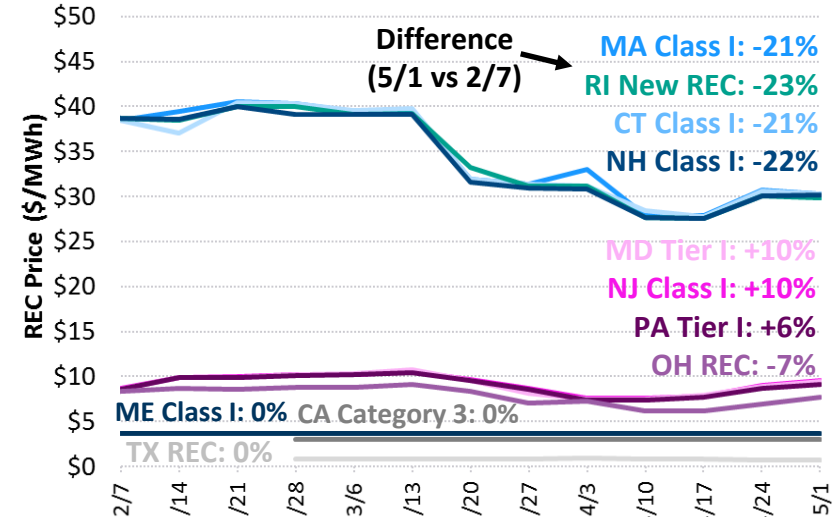
- Class/Tier I RECs generally decreased in prices from February to today, particularly in New England.
- SREC prices seem less affected.

Total Solar and Wind Curtailments in CAISO^{42,73}



Source: CAISO; Velocity Suite, ABB Inc., accessed May 1, 2020.

2020 Index REC Prices⁷⁴



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Source: S&P Market Intelligence, as of May 4 2020.

Renewable Energy Long Term Development Plans & Incentives

Slowing?

There is an increasing number of reported project delays/cancellations, equipment sourcing challenges, supply chain and construction delays, and potential layoffs of employees.^{75,76,77}

- NYSEERDA announced pause in NY 2020 offshore wind solicitation (1,000-2,500 MW), but with no reductions in long term goals.⁷⁸
- New Jersey, New York, Pennsylvania, and Michigan have suspended renewables construction during the pandemic, as part of non-essential construction stoppage.^{79,80,81,82}
- Unemployment claims data shows that the clean energy industries lost 106,472 jobs in March (a 3% drop in the workforce), and forecasts estimate up to 15% drop if no actions to support the industries.⁸³

Financing risk and uncertainty are compounding delays.⁸⁴

- While interest rates are down, lender credit standards are more stringent.
- Tax equity may be squeezed by lower taxable income among investors.

Potential consolidation of small developers.

Growing?

Worldwide lockdowns and social distancing measures have triggered a historic decline in emissions, increasing public appreciation for improved climate conditions.⁸⁵

- IEA estimates an 8% global reduction in CO2 emissions relative to 2019, the lowest emissions levels since 2010.¹⁴
- This is far above the annual reductions under the 2015 Clean Power Plan, which aimed to reduce US CO2 emissions 32% below 2005 levels by 2030.⁸⁶

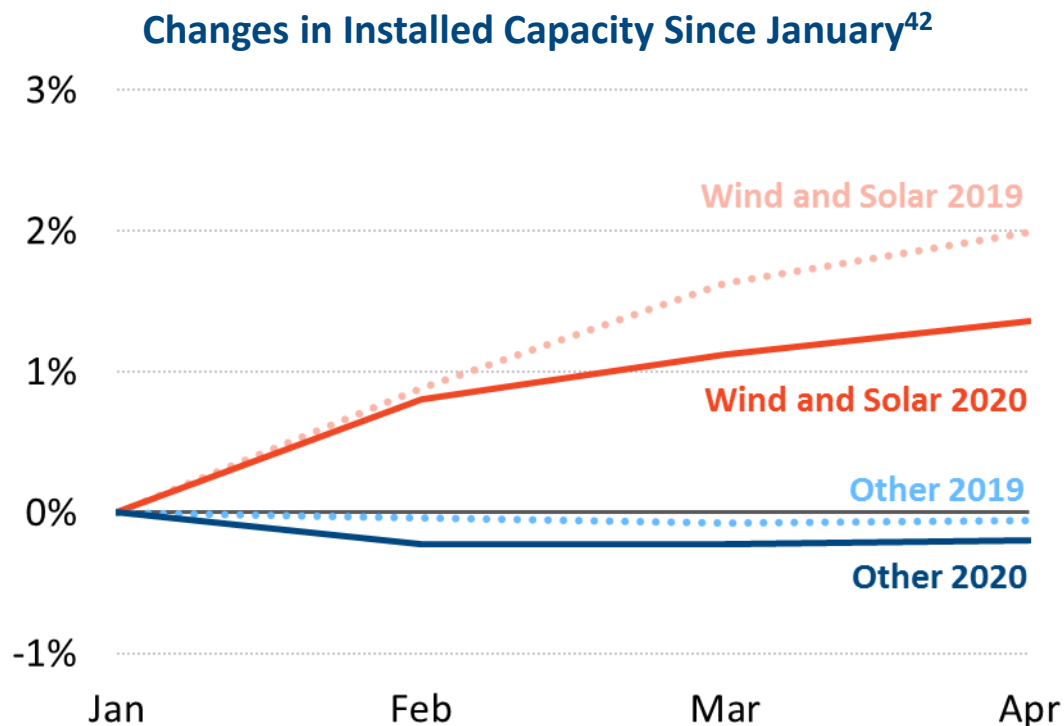
Several states have affirmed continued commitments to long term clean energy policies.

- New York governor unveiled details of 21 large-scale solar, wind, and energy storage projects (1,278 MW) across upstate NY in March.⁸⁷
- The Virginia Clean Economy Act, signed in April, sets goals of 5,200 MW of offshore wind by 2034 and 3,100 MW of storage by 2035.⁸⁸

Renewable Energy Long Term Development Plans & Incentives

US renewable capacity is still growing at approximately 700 MW per month since January 2020, reaching almost 13% of total installed capacity in April.

- This pace is somewhat off same period last year, which was 900 MW per month.



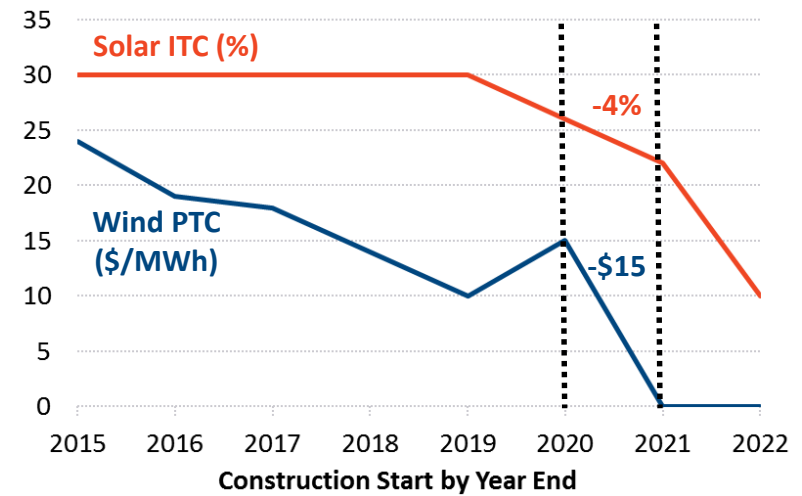
Source: Velocity Suite, ABB Inc., accessed May 5, 2020.

Renewable Energy Long Term Development Plans & Incentives

Delays in construction caused by policy, manufacturing/supply chain, or financial challenges could be compounded by expiring tax incentives.⁸⁹

- Wind and solar projects are at risk for losing their tax incentives (\$15/MWh and 4% ITC, respectively), which require construction start by year-end 2020.
- Separately, wind projects that qualified for the PTC in 2016—at \$19/MWh—could lose the credit if in-service is delayed beyond year-end 2020.
- Renewable energy industry groups are lobbying Congress for extensions of federal tax credits and safe harbor provisions as well as “direct pay” options to facilitate monetization.^{90,91}

Current Phase-Out of Renewable Tax Incentives^{92,93}



2020 Year-End Tax Incentives at Stake

	Wind PTC (\$/MWh)	Solar ITC (%)
Development Projects	\$15	4%
2016 Construction Projects	\$19	-

Note: Wind projects started in 2016 are eligible for \$19 PTC if completed by 2020.

Renewable Energy Stock Prices

There has been a mixed performance by renewable stocks, compared to the S&P 500 and utility index, with some stocks outperforming the greater market while others are underperforming – no basis for a COVID effect yet.

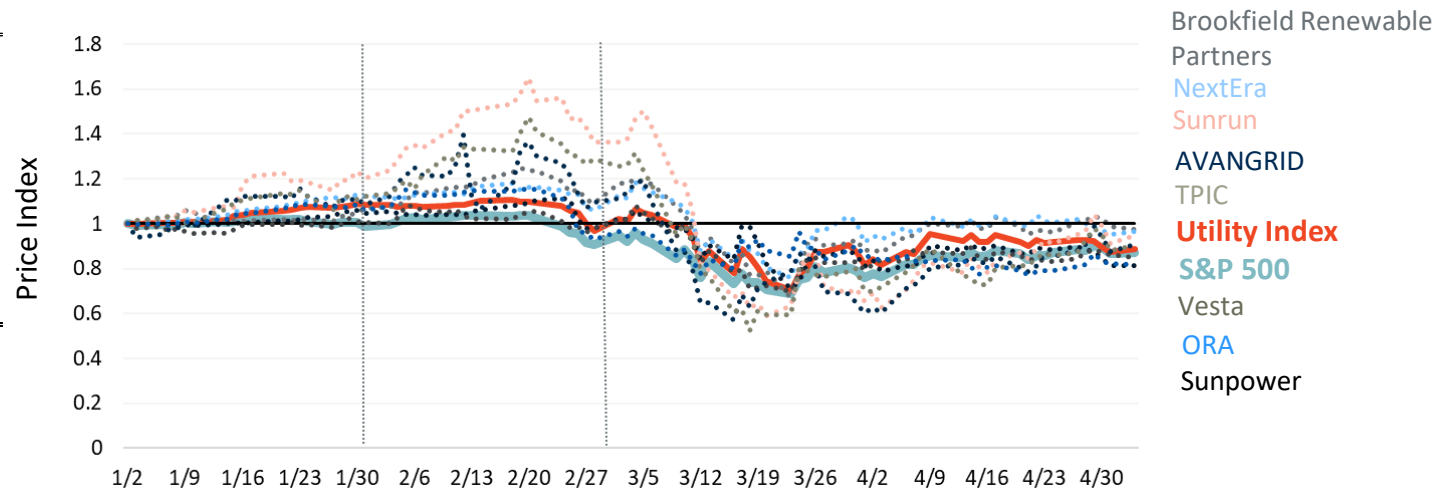
- The renewable companies in our analysis have varying betas, ranging from 0.4 to 1.5, with about half of the companies in our sample showing a beta above 1, implying they may react to the change in market more than the S&P 500.
- And individual companies are intrinsically more volatile than the market or industry indices.

Betas of Renewable Companies⁹⁴

Brookfield Renewable Partners	1.15
NextEra	0.50
Sunpower	1.50
Sunrun	1.25
Ormat Technologies (ORA)	0.80
Investar Holding Corporation (Vesta)	0.60
AVANGRID	0.40
TPI Composites	1.30

*Brookfield Asset Management's beta is used for Brookfield Renewable Partners, as it is the parent company.

Stock Price Performance of Renewable Stock vs. General Market



Source: Bloomberg, as of May 4, 2020.

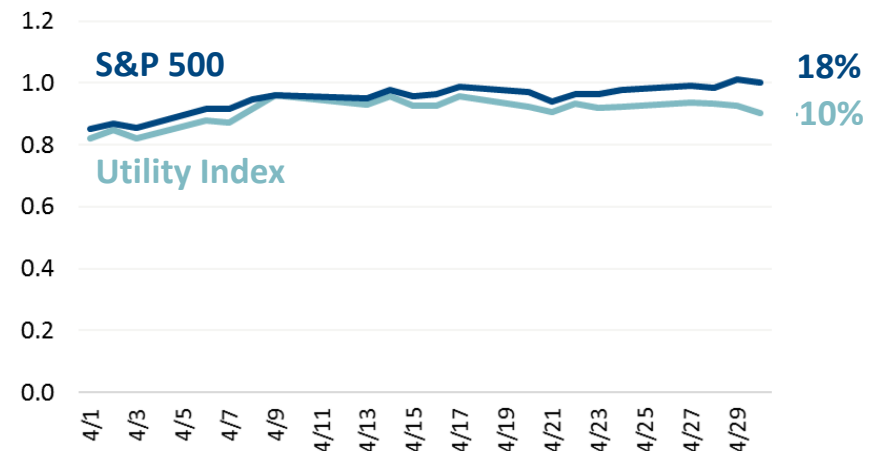
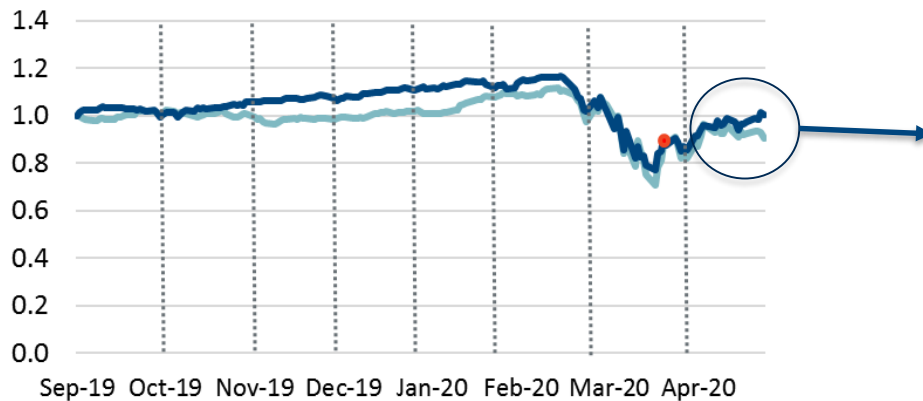
Financial Impacts — Utility Stock Prices

Altered financial conditions affect utility cost of capital, liquidity, hedging, perhaps capex programs, and IRP expansion timing or choices.

Through the beginning of April, utility stock prices have generally continued to follow the overall market trends, but more recently have been lagging behind the S&P 500.

- In April, the utility index price gained 10%, while the S&P improved 18% -- despite utilities having less reported difficulty hitting earnings targets and offering attractive nearly fixed dividends
- May suggest some investors question utilities' ability to recover lost revenues.

Historical Stock Prices



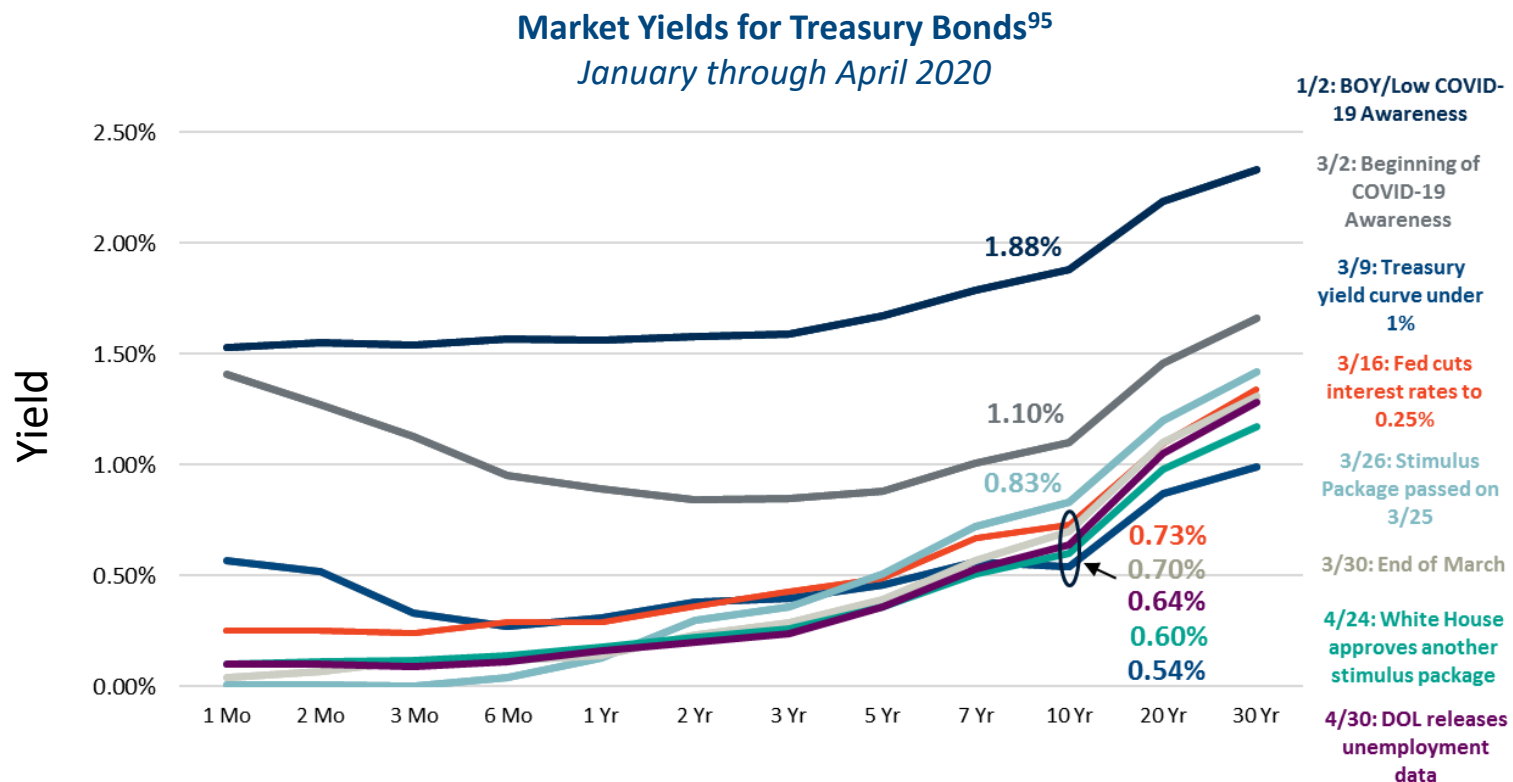
Note: S&P Utility Index includes electric, gas, and water utilities.

Source: Bloomberg, data as of April 30, 2020.

Treasury Yields

Recent treasury yields are at historic lows, with most of the change in March followed by relatively unchanged low yields in April.

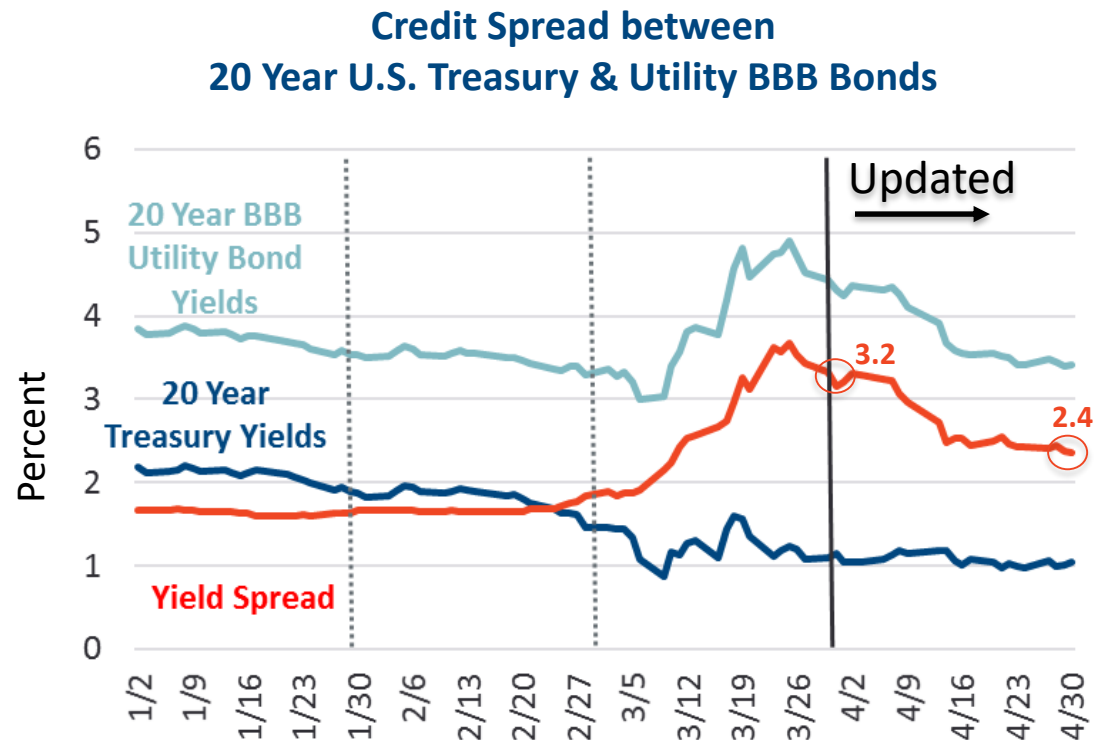
- 10-year yields in April hit a monthly low of 0.58%, only 4 basis points above the March low of 0.54%.



Corporate vs. Fed Bond Credit Spreads

Yield spreads between 20-year treasury bonds and utility BBB bonds declined by 80 bps (26%) in April.

- Although 20 year yield spreads declined in April, they are still up 42% compared to the beginning of 2020.
- The increased spread, compared to the beginning of the year, is driven by both the decrease in treasury bills and a significant mid-March increase in BBB bond yields.
 - However, BBB utility bond yields have been declining in April, while 20 year treasury yields have stayed fairly constant.



Source: Bloomberg, data as of April 30, 2020.

Credit Rating Agency Actions

On April 2, S&P Global Ratings downgraded the outlook for North American investor owned utilities from “stable” to “negative” due to COVID-19 risk.⁹⁶

S&P Credit Downgrades in March & April 2020

Company	Date	Downgrade
PNM Resources, Inc.	4/6/2020	Action: Downgrade from "BBB+" to "BBB"
Texas-New Mexico Power Company	4/6/2020	Action: Downgrade from "A-" to "BBB+"
ALLETE	4/22/2020	Action: Downgrade from "BBB+" to "BBB"

Since the beginning of March, S&P has downgraded only 3 electric utilities -- for inadequate coverage ratios compounded by the uncertainty and liquidity risks from the pandemic.⁹⁷

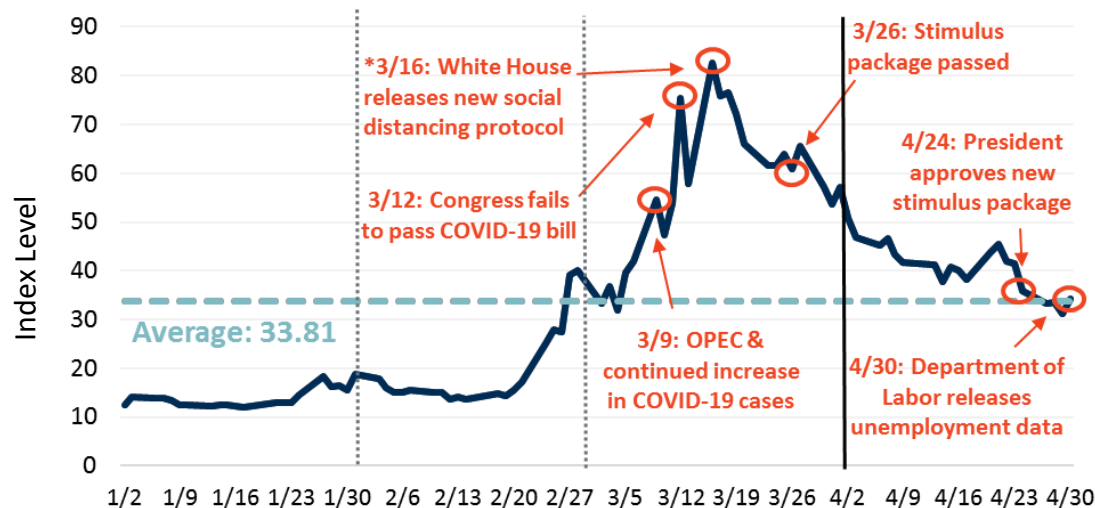
On April 22, Moody's affirmed “stable” outlook for the US public power sector, but cautioned that public power companies will likely have restricted liquidity and lessened coverage ratios for the next two years.⁹⁸

Market Volatility

Volatility has steadily declined from its peak of 82.69 in mid-March, but remains elevated at about the same average as in the Great Financial Crisis of 2008-09.

- Investors require higher equity returns during times of heightened uncertainty.

VIX Historic Index Levels



	Dot Com, 9/11 2000 - 2002	Hurricane Katrina 2003 - 2006	Financial Crisis 2008-2009	Post-Crisis 2009-2012	Modern Era 2013-2019	COVID-19 Mar-20	COVID-19 Apr-20
VIX Index Average	25.4	14.9	35.1	22.7	14.9	57.7	41.5
Utilities as % of S&P 500	6.8%	6.4%	6.2%	6.2%	5.5%	5.5%	5.5%

Note: For context, during the Great Recession, VIX reached a peak of 80.86 on November 20, 2008.

Source: Bloomberg, data as of April 30, 2020.

Takeaways

Direct impacts of social distancing are probably as extreme in April as we can expect.

- About 6.5% reductions in average electric load beyond normal seasonal effects
- Almost no discernable reductions in overall natural gas demand, with residential load up slightly in April and perhaps 7-10% reduction in industrial usage
- Power sector demand for natural gas is up 4% in April compared to 2019 due to capacity expansion, but capacity factors are down due to load reductions.

Revenue impacts on utilities are likely to be smaller than load impacts, due to increased residential load and demand charges for C&I customers.

- COVID-specific decoupling measures are becoming widely sought and mostly approved.

Load reductions are affecting coal and gas generation more acutely than other fuel types.

- No discernable reductions in renewable generation due to COVID-19
- 4.9 GW of overall generation expansion is delayed to later in the year
- Delays in renewables could be aggravated by expiring tax incentives

Market volatility has declined to about 2008/09 levels, while the S&P 500 has rebounded to roughly September 2019 levels; utilities increased more slowly than the overall market in April.

- Only 3 credit downgrades for electric utilities, but S&P changed the outlook for utilities to 'negative'
- Bond yield spreads decline but are still high compared to beginning of year

Prepared By



Frank Graves
Principal, Boston

Frank is a Principal and co-founder of The Brattle Group with expertise in most aspects of long term utility planning, ratemaking and finance. Recently he has focused on financial and operating implications for utilities, their customers, and energy markets of heightened use of distributed energy resources and strong decarbonization goals, as well as resiliency to extreme “black swan” events.



Bob Mudge
Principal, Wash. D.C.

Mr. Mudge consults on matters concerning utility financial restructuring, credit requirements, rate design, valuation, and cost of capital. He has provided expert testimony before federal and state courts, utility and environmental regulators in the U.S. and Canada, and multiple arbitration venues. Recently, Mr. Mudge was a co-author of Brattle “white papers” on the financial implications of wildfires for California utilities.



Josh Figueroa
Associate, Boston

Josh is an Associate at Brattle focused on economic and financial topics in the energy sector with expertise in energy markets, infrastructure development, and mergers & acquisitions. Prior to joining Brattle, Mr. Figueroa worked for Con Edison Transmission leading acquisition and development of electric and natural gas transmission assets. Mr. Figueroa has an MBA from NYU’s Stern School of Business.



Tess Counts
Research Analyst, Boston

Tess is a Research Analyst with a focus on utility financial analysis, cost of capital, and resiliency. She has expertise in Brattle’s system dynamics models of long term electric distribution opportunities and risks, as well as in distressed asset valuations and California wildfire risk assessment. Her background is in economics from Wesleyan University.

Sources

- 1: Lambert, Lance, “Real unemployment rate soars past 20% - and the U.S. has now lost 26.5 million jobs”, *Fortune*, April 23, 2020. <https://fortune.com/2020/04/23/us-unemployment-rate-numbers-claims-this-week-total-job-losses-april-23-2020-benefits-claims/>
- 2: Heymi Bahar, “The coronavirus pandemic could derail renewable energy’s progress. Governments can help,” *International Energy Agency*, April 4, 2020. Accessed May 7, 2020. <https://www.iea.org/commentaries/the-coronavirus-pandemic-could-derail-renewable-energy-s-progress-governments-can-help>
- 3: Institute for Health Metrics and Evaluation. “COVID-19 Projections.” Accessed May 5, 2020. <https://covid19.healthdata.org/projections>
- 4: Ryan Best and Jay Boyce, “Where The Latest COVID-19 Models Think We're Headed – And Why They Disagree,” *FiveThirtyEight*. Accessed May 5, 2020, <https://projects.fivethirtyeight.com/covid-forecasts/>.
- 5: Nick Routley, “Infection Trajectory: See Which Countries are Flattening Their COVID-19 Curve,” *Visual Capitalist*, March 16, 2020. Accessed May 3, 2020, <https://www.visualcapitalist.com/infection-trajectory-flattening-the-covid19-curve/>.
- 6: Borodovsky, Lev, “The Daily Shot: U.S. Savings Rate Spikes”, May 1, 2020. <https://blogs.wsj.com/dailyshot/2020/05/01/the-daily-shot-u-s-savings-rate-spikes/>
- 7: Dean & Company, “COVID-19 Impact on US Economy and stock market”, March 6, 2020. <https://static1.squarespace.com/static/55b96b86e4b094666dbd482f/t/5eb5e26d76d5d265c52153cd/1588978288797/2020-05-08+COVID+Impact+vE.pdf>
- 8: Bureau of Economic Analysis, “Gross Domestic Product by Industry: Fourth Quarter and Year 2019”, Released April 6, 2020. Data accessed May 6, 2020. <https://www.bea.gov/data/gdp/gdp-industry>
- 9: Strategy&, PwC, “COVID-19 Pandemic and the US Financial Service Sector”, April 27, 2020.
- 10: Goldman Sachs, “The First Wave Crests”, May 3, 2020.
- 11: Goldman Sachs, “S&P 500 Trumps Gold”, April 5, 2020, accessed April 5, 2020.
- 12: S&P Global Market Intelligence, Oil & Refined Products Summary, February 1, 2020 through April 30, 2020. Accessed May 1, 2020, <https://platform.marketintelligence.spglobal.com/web/client?auth=inherit#markets/OilSummary>.
- 13: U.S. Energy Information Administration, “Weekly Petroleum Status Report,” Week Ending May 1, 2020. Accessed May 6, 2020, <https://www.eia.gov/petroleum/supply/weekly/>.
- 14: International Energy Agency, “Global Energy Review 2020,” April 2020. Accessed May 1, 2020, <https://www.iea.org/reports/global-energy-review-2020>.

Sources

- 15: Alex Lawer, "OPEC April oil output surges to 13-month high before new cut deal," *Reuters*, April 30, 2020. Accessed May 1, 2020, https://www.reuters.com/article/oil-opecc-survey/opecc-april-oil-output-surges-to-13-month-high-before-new-cut-deal-idUSL8N2Ci8JG?mod=article_inline.
- 16: U.S. Energy Information Administration, "Weekly Petroleum Status Report," Week Ending April 24, 2020 and Week Ending March 27, 2020. Accessed May 1, 2020, <https://www.eia.gov/petroleum/supply/weekly/>.
- 17: Terje Solsvik, "Norway to reduce oil output from June to December: oil ministry," *Reuters*, April 29, 2020. Accessed May 1, 2020, <https://www.reuters.com/article/us-global-oil-norway/norway-to-reduce-oil-output-from-june-to-december-oil-ministry-idUSKBN22B37P>.
- 18: S&P Global Market Intelligence, Futures, February 1, 2020, March 31, 2020 and April 30, 2020. Accessed May 1, 2020, <https://platform.marketintelligence.spglobal.com/web/client?auth=inherit#markets/commoditiesChart>.
- 19: Ron Bousso and Shadia Nasralla, "Shell cuts dividend for first time since World War Two," *Reuters*, April 30, 2020. Accessed May 1, 2020, <https://www.reuters.com/article/us-shell-results/shell-cuts-dividend-for-first-time-since-world-war-two-idUSKBN22C0TK>.
- 20: Arathy S Nair and Gary McWilliams, "Exxon posts first loss in 30 years on writedown, oil price plunge," *Reuters*, May 1, 2020. Accessed May 1, 2020, <https://www.reuters.com/article/us-exxon-mobil-results/exxon-posts-first-loss-in-30-years-on-writedown-oil-price-plunge-idUSKBN22D5BL>.
- 21: Nicole Serin and Sudeep K. Kesh, "COVID-19: Coronavirus and oil price-related public rating actions on corporations, sovereigns, and project finance to date," *S&P Global Ratings*, April 29, 2020. Accessed May 1, 2020, <https://www.spglobal.com/ratings/en/research/articles/200318-covid-19-coronavirus-related-public-rating-actions-on-non-financial-corporations-to-date-11393186>.
- 22: Amanda Luhavalja, "Update: 12 oil majors to slash capex by \$43.6B amid price collapse, coronavirus," *S&P Global Market Intelligence*, April 7, 2020. Accessed May 1, 2020, <https://www.spglobal.com/marketintelligence/en/news-insights/latest-news-headlines/update-12-oil-majors-to-slash-capex-by-43-6b-amid-price-collapse-coronavirus-57718263>.
- 23: Haynes and Boone, LLP, "Haynes and Boone, LLP Oil Patch Bankruptcy Monitor," April 6, 2020. <https://www.haynesboone.com/publications/energy-bankruptcy-monitors-and-surveys>
- 24: Debtwire, "Restructuring Insights," March 2020.
- 25: Rick Schuman, "INRIX U.S. National Traffic Volume Synopsis: Issue #7 (April 25 – May 1, 2020)," *INRIX*, May 4, 2020. Accessed May 4, 2020, <https://inrix.com/blog/2020/05/covid19-us-traffic-volume-synopsis-7/>.
- 26: Ben German, "Ford and Rivian scrap joint electric vehicle plan amid coronavirus crisis," *Axios*, April 29, 2020. Accessed May 4, 2020, <https://www.axios.com/ford-rivian-electric-vehicles-lincoln-8227c41f-e74a-4500-895d-23b8bcd45abc.html>.
- 27: U.S. Energy Information Administration, "Weekly Retail Gasoline and Diesel Prices." Accessed May 1, 2020, https://www.eia.gov/dnav/pet/pet_pri_gnd_dcus_nus_w.htm.

Sources

- 28: National Oceanic and Atmospheric Administration, National Weather Service Climate Prediction Center, “U.S. Daily Temperature Analyses,” Accessed May 1, 2020, https://www.cpc.ncep.noaa.gov/products/tanal/temp_analyses.php.
- 29: U.S. Energy Information Administration, “Natural Gas Storage Dashboard.” Accessed May 1, 2020, <https://www.eia.gov/naturalgas/storage/dashboard/>.
- 30: Manussawee Sukunta, “Today in Energy: Wind and natural gas-fired generators led U.S. power sector capacity additions in 2019,” U.S. Energy Information Administration, April 21, 2020. Accessed May 1, 2020 <https://www.eia.gov/todayinenergy/detail.php?id=43415>.
- 31: S&P Global Market Intelligence, Day-Ahead Natural Gas Prices - Daily, February 1, 2020 through April 30, 2020. Accessed, May 1, 2020, <https://platform.marketintelligence.spglobal.com/web/client?auth=inherit#markets/commoditiesChart>.
- 32: Ryan Dezimmer and Matt Wirz, “Rising natural gas prices are a hot bet,” *The Wall Street Journal*, May 1, 2020. Accessed May 1, 2020, <https://www.wsj.com/articles/rising-natural-gas-prices-are-a-hot-bet-11588339279>.
- 33: S&P Global Market Intelligence, Natural Gas Forwards & Futures, February 1, 2020, March 31, 2020, and April 3, 2020. Accessed April 3, 2020, <https://platform.marketintelligence.spglobal.com/web/client?auth=inherit#markets/commoditiesChart>.
- 34: ICIS Heren LNG Edge database. Accessed April 28, 2020.
- 35: Poten & Partners, “Webinar: 2020 LNG Markets and COVID-19 – What Happens Next?” April 22, 2020. Accessed May 1, 2020, <https://www.poten.com/webinar-2020-lng-markets-and-covid-19-what-happens-next-april-22-webinar>.
- 36: Natural Gas Intel, “LNG Insight”, April 30, 2020. Accessed April 30, 2020, <https://www.naturalgasintel.com/gulf-coast-lng-netbacks>.
- 37: Scott DiSavino and Arathy S. Nair, “Sempra delays big Texas LNG project as global energy demand slumps,” *Reuters*, May 4, 2020. Accessed May 4, 2020, <https://www.reuters.com/article/us-sempra-usa-results/sempra-delays-investment-decision-on-its-texas-lng-export-plant-to-2021-idUSKBN22G1IS>.
- 38: Corey Paul, “Wave of LNG cargo cancellations to start as soon as June: shipbroker,” *S&P Global Platts*, April 23, 2020. Accessed May 1, 2020, <https://www.spglobal.com/platts/en/market-insights/latest-news/natural-gas/042220-wave-of-lng-cargo-cancellations-to-start-as-soon-as-june-shipbroker>.
- 39: U.S. Department of Energy Office of Oil & Natural Gas, “LNG Monthly,” February 2020. Accessed May 1, 2020, <https://www.energy.gov/fe/downloads/lng-annual-report-2019>.
- 40: Carolyn Davis, “U.S. Natural Gas Seen Moving Above \$3 as operators shut-in oil wells,” *Natural Gas Intel*, April 13, 2020. Accessed May 1, 2020, <https://www.naturalgasintel.com/articles/121643-us-natural-gas-seen-moving-above-3-as-operators-shut-in-oil-wells>.
- 41: U.S. Energy Information Administration, “Natural Gas Monthly,” August 30, 2019. Accessed May 1, 2020, https://www.eia.gov/naturalgas/monthly/archive/2019/2019_08/ngm_2019_08.php.

Sources

- 42: Velocity Suite, ABB Inc., data as of April 30, 2020. Accessed May 1, 2020.
- 43: Darrell Proctor, "Power Loads Changing as Coronavirus Impacts Energy Sector," *Power Magazine*, March 23, 2020. Accessed May 5, 2020, <https://www.powermag.com/blog/power-loads-changing-as-coronavirus-impacts-energy-sector/>.
- 44: S&P Global Market Intelligence, Monthly Generation, February 2020, and March 2020. Accessed April 13, 2020, <https://platform.marketintelligence.spglobal.com/web/client?auth=inherit#industry/monthlyGeneration>.
- 45: EIA, Electric Power Monthly, "Table 1.1 Net Generation by Energy Source: Total (All Sectors), 2010-January 2020", March 24, 2020. Accessed April 13, 2020. https://www.eia.gov/electricity/monthly/epm_table_grapher.php?t=epmt_1_01
- 46: "PJM Coronavirus (COVID-19) Information," PJM Interconnection, LLC press release, April 15, 2020. Accessed April 18, 2020, <https://www.pjm.com/about-pjm/newsroom/info-connection.aspx>.
- 47: California ISO, "COVID-19 Impacts to California ISO Load & Markets: March 17 - April 12, 2020," accessed April 28, 2020, <http://www.caiso.com/Documents/COVID-19-Impacts-ISOLoadForecast-Presentation.pdf>.
- 48: Calvin Opheim, "COVID-19 Load Impact Analysis," ERCOT, accessed April 28, 2020, http://www.ercot.com/content/wcm/lists/200201/ERCOT_COVID-19_Analysis_FINAL.pdf.
- 49: Midcontinent Independent System Operator, "COVID-19 Impact to Load & Outage Coordination," April 13, 2020. Accessed April 28, 2020, https://cdn.misoenergy.org/COVID%2019%20Impacts%20to%20MISO%20Load%20and%20Outage_as%20of%20April%2010%20Final442224.pdf.
- 50: ISO New England, "Forecasting consumer demand during the COVID-19 pandemic," *ISO-NEWSWIRE*, March 31, 2020. Accessed April 28, 2020, <http://isonewswire.com/updates/2020/3/31/forecasting-consumer-demand-during-the-covid-19-pandemic.html>.
- 51: New York Independent System Operator, "COVID-19 Related Updates." Accessed April 28, 2020, <https://www.nyiso.com/covid>.
- 52: Southwest Power Pool, Inc., "SPP's COVID-19 Response - April 16, 2020," Southwest Power Pool, Inc. press release, April 16, 2020. Accessed April 28, 2020, <https://spp.org/newsroom/covid-19/spps-covid-19-response-april-16-2020/>.
- 53: Darrell Proctor, "EIA Notes Power Demand Destruction from Coronavirus," *Power Magazine*, April 7, 2020. Accessed April 28, 2020. <https://www.powermag.com/eia-notes-power-demand-destruction-from-coronavirus/>.
- 54: Scott Disavino, "COVID-19: America hasn't used this little energy in 16 years," *World Economic Forum*, April 14, 2020, Accessed April 28, 2020, <https://www.weforum.org/agenda/2020/04/united-states-energy-electricity-power-coronavirus-covid19/>.
- 55: S&P Global Market Intelligence, Peak Power Price Forwards, February 30, 2020. Accessed May 2, 2020, <https://platform.marketintelligence.spglobal.com/web/client?auth=inherit#markets/commoditiesChart>.
- 56: Lillian Federico, "More regulators taking a look at COVID-19 impacts on utilities," *S&P Global Market Intelligence*, April 27, 2020. Accessed May 5, 2020, <https://platform.marketintelligence.spglobal.com/web/client?auth=inherit#news/article?id=58155966&KeyProductLinkType=14>.

Sources

- 57: National Association of Regulatory Utility Commissioners, “State Response Tracker.” Accessed May 3, 2020, <https://www.naruc.org/compilation-of-covid-19-news-resources/state-response-tracker/>.
- 58: U.S. Bureau of Labor Statistics, “Unemployment Rates for States, Seasonally Adjusted”, April 17, 2020. accessed May 6, 2020, <https://www.bls.gov/web/laus/laumstrk.htm>.
- 59: Michael Horrigan, Jim Robey, Katie Bolter, Gerrit Anderson, “Initial unemployment claims slowed nationally and in Michigan but remain near record levels,” *The Upjohn Institute*, April 30, 2020. Accessed, May 5, 2020, <https://www.upjohn.org/research-highlights/initial-unemployment-claims-slowed-nationally-and-michigan-remain-near-record-levels>.
- 60: National Rural Electric Cooperative Association, “Financial Impact of COVID-19 on Electric Cooperatives: \$7.4 Billion Hit on Operating Revenues and \$2.6 Billion in Unpaid Bills,” April 21, 2020. Accessed May 5, 2020, <https://www.electric.coop/wp-content/uploads/2020/04/Financial-Impact-of-Load-Loss-and-Unpaid-Bills-on-Electric-Cooperatives-042120.pdf>.
- 61: National Rural Electric Cooperative Association, Letter to Congressional Leadership, April 6, 2020. Accessed May 5, 2020, https://www.eenews.net/assets/2020/05/06/document_ew_01.pdf.
- 62: National Rural Electric Cooperative Association, America’s Electric Cooperative Network Map. Accessed May 5, 2020, <https://www.wyomingrea.org/about/nreca-coop-map-small/>.
- 63: U.S. Energy Information Administration, “2018 Utility Bundled Retail Sales – Total, EIA-861 – schedules 4A & 4D and EIA-861S.” Accessed May 6, 2020, <https://www.eia.gov/electricity/data.php#sales>.
- 64: National Rural Electric Cooperative Association, “America’s Electric Cooperatives,” October 11, 2019. Accessed May 5, 2020, https://www.electric.coop/wp-content/uploads/2019/10/Co-op-Facts-and-Figures_WEB_PAGES_10-11-19.pdf.
- 65: Joe Ryan, “Virus May Nix 39% of Projects to Build New U.S. Power Plants,” Bloomberg L.P., April 8, 2020. Accessed April 9, 2020. <https://news.bloomberglaw.com/environment-and-energy/covid-19-seen-canceling-up-to-39-of-new-u-s-power-generation>.
- 66: ISO New England Inc., “Daily Generation by Fuel Type.” Accessed April 2, 2020. <https://www.iso-ne.com/isoexpress/web/reports/operations/-/tree/daily-gen-fuel-type>.
- 67: The New York Independent System Operator Inc., “Real-Time Fuel Mix.” Accessed April 2, 2020, <http://mis.nyiso.com/public/P-63list.htm>.
- 68: PJM Interconnection, LLC, “Generation by Fuel Type.” Accessed April 2, 2020, https://dataminer2.pjm.com/feed/gen_by_fuel.

Sources

- 69: Midcontinent Independent System Operator, "Generational Fuel Mix (xlsx)." Accessed May 1, 2020, [https://www.misoenergy.org/markets-and-operations/real-time--market-data/market-reports/#nt=%2FMarketReportType%3ASummary%2FMarketReportName%3AGeneration%20Fuel%20Mix%20\(xlsx\)&t=10&p=3&s=MarketReportPublished&sd=desc](https://www.misoenergy.org/markets-and-operations/real-time--market-data/market-reports/#nt=%2FMarketReportType%3ASummary%2FMarketReportName%3AGeneration%20Fuel%20Mix%20(xlsx)&t=10&p=3&s=MarketReportPublished&sd=desc).
- 70: Southwest Power Pool, Inc., "GenMixYTD." Accessed May 1, 2020, <https://marketplace.spp.org/pages/generation-mix-historical>.
- 71: California ISO, "Supply." Accessed May 4, 2020, <http://www.caiso.com/TodaysOutlook/Pages/Supply.aspx>.
- 72: Electric Reliability Council of Texas, "Fuel Mix Report." Accessed May 1, 2020, <http://www.ercot.com/gridinfo/generation>.
- 73: California ISO, "Managing oversupply." Accessed 5 May 2020, <http://www.caiso.com/informed/Pages/ManagingOversupply.aspx>.
- 74: S&P Global Market Intelligence, Renewable Energy Credits. Accessed May 4, 2020, <https://platform.marketintelligence.spglobal.com/web/client?auth=inherit#markets/rec>.
- 75: American Wind Energy Association, "Wind Powers America: First Quarter 2020 Report," <https://www.awea.org/resources/publications-and-reports/market-reports/2020-u-s-wind-industry-market-reports-1>.
- 76: Abigail Ross Hopper, "Survey Findings: Things are bad and getting worse," Solar Energy Industries Association, March 26, 2020. Accessed May 5, 2020, <https://www.seia.org/blog/survey-findings-things-are-badB-and-getting-worse>.
- 77: Energy Storage Association, "Impacts of COVID-19 on the Energy Storage Industry," https://energystorage.org/wp/wp-content/uploads/2020/04/2020-COVID-report_FINAL-2.pdf.
- 78: Iulia Gheorghiu, "New York hits the brakes on 2.5 GW solicitation of offshore wind due to COVID-19," Utility Dive, April 24, 2020, <https://www.utilitydive.com/news/new-york-hits-the-brakes-on-25-gw-solicitation-of-offshore-wind-due-to-cov/576712/>.
- 79: "Governor Murphy Signs Executive Order to Cease All Non-Essential Construction Projects and Imposes Additional Mitigation Requirements on Essential Retail Businesses and Industries to Limit the Spread of COVID-19," Office of the Governor of the State of New Jersey news release, April 8, 2020. Accessed May 5, 2020, <https://www.nj.gov/governor/news/news/562020/20200408e.shtml>.
- 80: State of New York, Empire State Development, "Frequently Asked Questions for Determining Whether a Business is Subject to a Workforce Reduction Under Recent Executive Order Enacted to Address COVID-19 Outbreak," Question 14, Accessed May 5, 2020, https://esd.ny.gov/sites/default/files/ESD_EssentialEmployerFAQ_033120.pdf.
- 81: "Wolf Administration Issues Guidance as Construction Industry Prepares to Resume Work May 1," Office of the Governor of the Commonwealth of Pennsylvania news release, April 23, 2020. Accessed May 5, 2020, <https://www.governor.pa.gov/newsroom/wolf-administration-issues-guidance-as-construction-industry-prepares-to-resume-work-may-1/>.
- 82: State of Michigan, "Executive Order 2020-21 FAQs [No longer effective]." Accessed May 5, 2020, https://www.michigan.gov/coronavirus/0,9753,7-406-98178_98455-522631--,00.html.

Sources

- 83: BW Research Partnership, “Clean Energy Employment Initial Impacts from the COVID-19 Economic Crisis, March 2020,” April 14, 2020. Accessed May 7, 2020, https://bwresearch.com/covid/BWResearch_CleanEnergyJobsInitialCOVID-19Memo.pdf.
- 84: Michael Copley, “Clouds gather over renewable energy financing,” S&P Global Market Intelligence, March 26, 2020. Accessed May 5, 2020, <https://www.spglobal.com/marketintelligence/en/news-insights/latest-news-headlines/clouds-gather-over-renewable-energy-financing-57758525>.
- 85: Brad Plumer, “Emissions Declines Will Set Records This Year. But It’s Not Good News.” The New York Times, April 30, 2020. Accessed May 5, 2020, <https://www.nytimes.com/2020/04/30/climate/global-emissions-decline.html>.
- 86: U.S. Environmental Protection Agency, “FACT SHEET: Overview of the Clean Power Plan.” Accessed May 5, 2020, <https://archive.epa.gov/epa/cleanpowerplan/fact-sheet-overview-clean-power-plan.html>.
- 87: “Governor Cuomo Announces Details for 21 Large-Scale Renewable Energy Projects to Deliver Clean, Affordable Energy to New Yorkers,” Office of the Governor of the State of New York press release, March 13, 2020. Accessed May 5, 2020, <https://www.governor.ny.gov/news/governor-cuomo-announces-details-21-large-scale-renewable-energy-projects-deliver-clean>.
- 88: Governor Northam Signs Clean Energy Legislation,” Office of the Governor of the Commonwealth of Virginia news release, April 12, 2020, <https://www.governor.virginia.gov/newsroom/all-releases/2020/april/headline-856056-en.html>.
- 89: “American Wind Energy Association Releases COVID-19 Outlook,” American Wind Energy Association press release, March 19, 2020. Accessed May 5, 2020, <https://www.awea.org/resources/news/2020/american-wind-energy-association-releases-covid-19>.
- 90: Letter from the American Council on Renewable Energy, American Wind Energy Association, Energy Storage Association, National Hydropower Association, Renewable Energy Buyers Alliance, and Solar Energy Industries Association to Congressional Leadership, March 19, 2020. Accessed May 5, 2020, <https://energystorage.org/wp/wp-content/uploads/2020/03/Renewable-Energy-Sector-Letter-Response-to-COVID-Final-March-19-2020.pdf>.
- 91: Letter from the Solar Industry to Congressional Leaders, March 23, 2020. Accessed May 5, 2020, <https://www.seia.org/sites/default/files/2020-03/Solar%20Industry%20Letter%20COVID-19%20Economic%20Stimulus%203-23-20.pdf>.
- 92: North Carolina Clean Energy Technology Center Database of State Incentives for Renewables & Efficiency, “Business Energy Investment Tax Credit (ITC),” last updated February 13, 2020. Accessed May 6, 2020, <https://programs.dsireusa.org/system/program/detail/658>.
- 93: U.S. Department of Energy Office of Energy Efficiency and Renewable Energy, “Advancing the Growth of the U.S. Wind Industry: Federal Incentives, Funding, and Partnership Opportunities,” February 2020. Accessed May 5, 2020, <https://www.energy.gov/sites/prod/files/2020/02/f71/weto-funding-factsheet-2020.pdf>.

Sources

94: Valueline, accessed April 22, 2020.

95: US Department of Treasury. 2020. "Daily Treasury Yield Curve Rates." Accessed May 2, 2020. <https://www.treasury.gov/resource-center/data-chart-center/interest-rates/Pages/TextView.aspx?data=yieldYear&year=2020>

96: S&P Global Market Intelligence, "20: S&P Global Market Intelligence, S&P lowers North American utilities outlook to negative on coronavirus risk," April 2, 2020, Accessed April 3, 2020, <https://www.spglobal.com/marketintelligence/en/news-insights/latest-news-headlines/s-p-lowers-north-american-utilities-outlook-to-negative-on-coronavirus-risk-57886477>.

97: S&P Global, "COVID-19: Coronavirus- And Oil Price-Related Public Rating Actions On Corporations, Sovereigns, And Project Finance To Date," May 4, 2020. Accessed May 5, 2020, <https://www.spglobal.com/ratings/en/research/articles/200318-covid-19-coronavirus-related-public-rating-actions-on-non-financial-corporations-to-date-11393186>.

98: Ellen Myers, "Moody's affirms stable US public power outlook despite COVID-19 headwinds," *S&P Global Market Intelligence*, April 23, 2020. Accessed May 5, 2020, <https://platform.marketintelligence.spglobal.com/web/client?auth=inherit#news/article?id=58170082&KeyProductLinkType=23>.

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