

Overview of Environmental Impacts of COVID-19 Pandemic

Planning Advisory Committee



Patricio Silva

LEAD ANALYST – PLANNING SERVICES, SYSTEM PLANNING



COVID-19 Pandemic Mitigation Measures

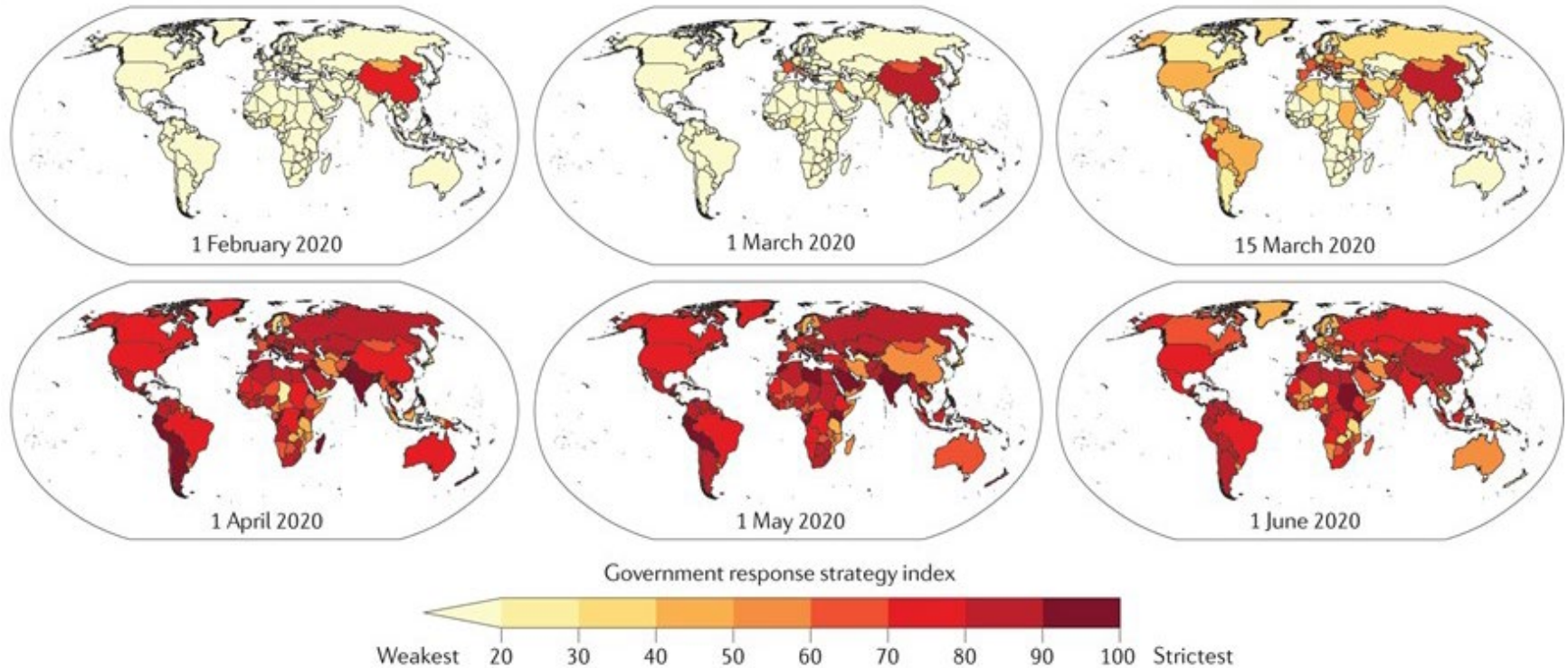
Preliminary Environmental Impacts Overview

- **Global Emissions Impacts**
 - April 2020 Global CO₂ emissions fell by 17% compared to April 2019
 - Significant declines in other, but not all, anthropogenic air pollutants
- **US COVID-19 Pandemic Mitigation Measures Impacts**
 - April 2020 CO₂ emissions from electric generation fell -16%
 - April 2020 total electric generation declined -7%
- **New England Pandemic Mitigation Measures Emission Impacts**
 - Regional economy-wide CO₂ emissions fell an estimated ~28-34%
 - Native electric generation estimated CO₂ emissions increased ~1.4%



GLOBAL ENVIRONMENTAL IMPACTS FROM COVID-19 PANDEMIC RESPONSES

Timing of COVID-19 Sheltering Measures Worldwide

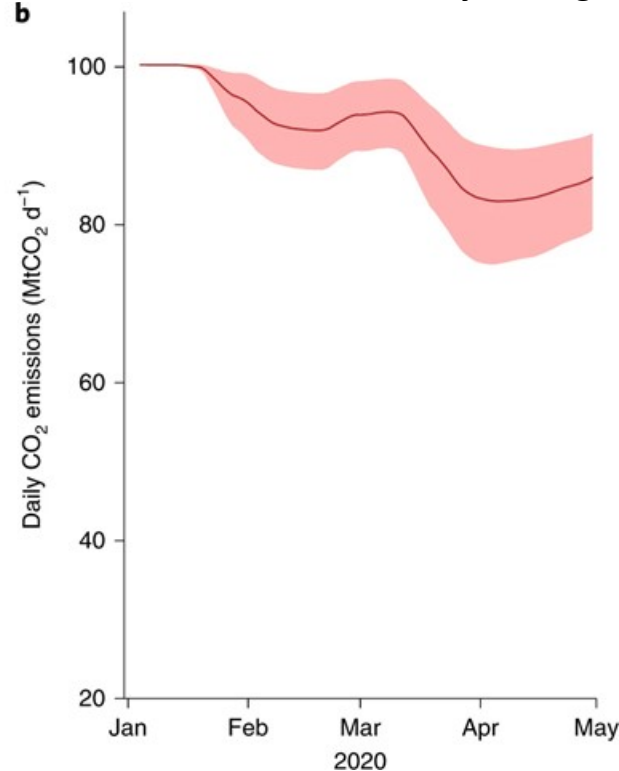
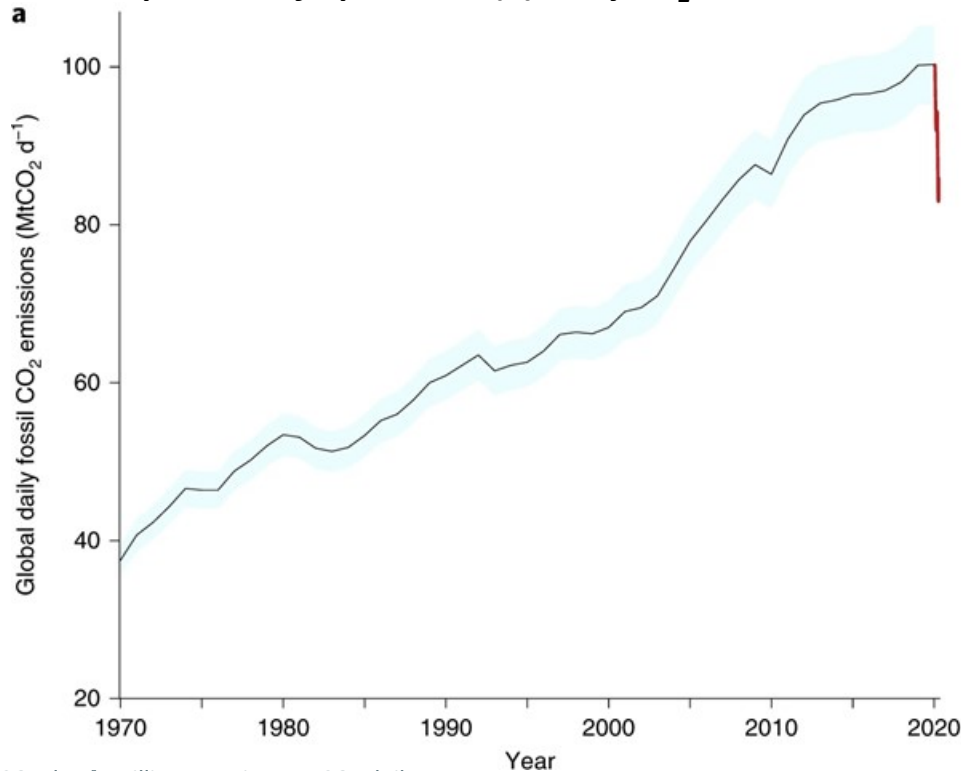


Oxford University COVID-19 Government Response Tracker on six different dates between February and June 2020.

Diffenbaugh, N.S., Field, C.B., Appel, E.A. et al. *The COVID-19 lockdowns: a window into the Earth System.* *Nat Rev Earth Environ* (2020). <https://doi.org/10.1038/s43017-020-0079-1>

Global CO₂ Emissions Annual Trend, Daily 2020

(a) Annual mean daily emissions in the period 1970–2019 (black line), red line shows the daily estimated emissions up to end of April 2020. (b) Daily CO₂ emissions in 2020, red line smoothed with a 7-day average



MtCO₂ day⁻¹: million metric tons CO₂ daily

Source: Nature Climate Change

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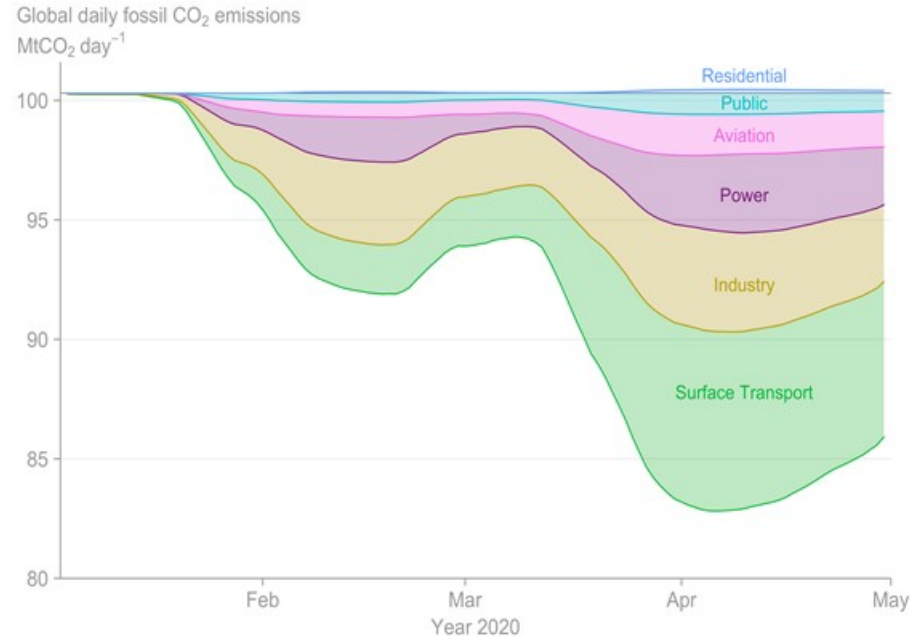
Le Quéré, C., Jackson, R.B., Jones, M.W. et al. Temporary reduction in daily global CO₂ emissions during the COVID-19 forced confinement. Nat. Clim. Chang. 10, 647–653 (2020). <https://doi.org/10.1038/s41558-020-0797-x>

Global CO₂ Emissions Fell Abruptly by April 2020

Transportation Sector – Surface, Aviation, Marine – Most Affected by Mitigation Measures Worldwide

Temporary Reduction in Global CO₂ Emissions Due to COVID-19 pandemic mitigation measures

- Daily global CO₂ emissions decreased by ~17% by early April 2020 compared with 2019 levels
 - Roughly half the total emissions attributed to decline in surface transportation activities
- At their peak, emissions in individual countries decreased by ~26% on average
- Depending on the duration of COVID-19 pandemic mitigation measures, global 2020 annual CO₂ emissions could decline by:
 - Low estimate: -4% (-2 to -7%) If pre-pandemic conditions return by mid-June 2020
 - High estimate: -7% (-3 to -13%) if some restrictions remain worldwide until the end of 2020

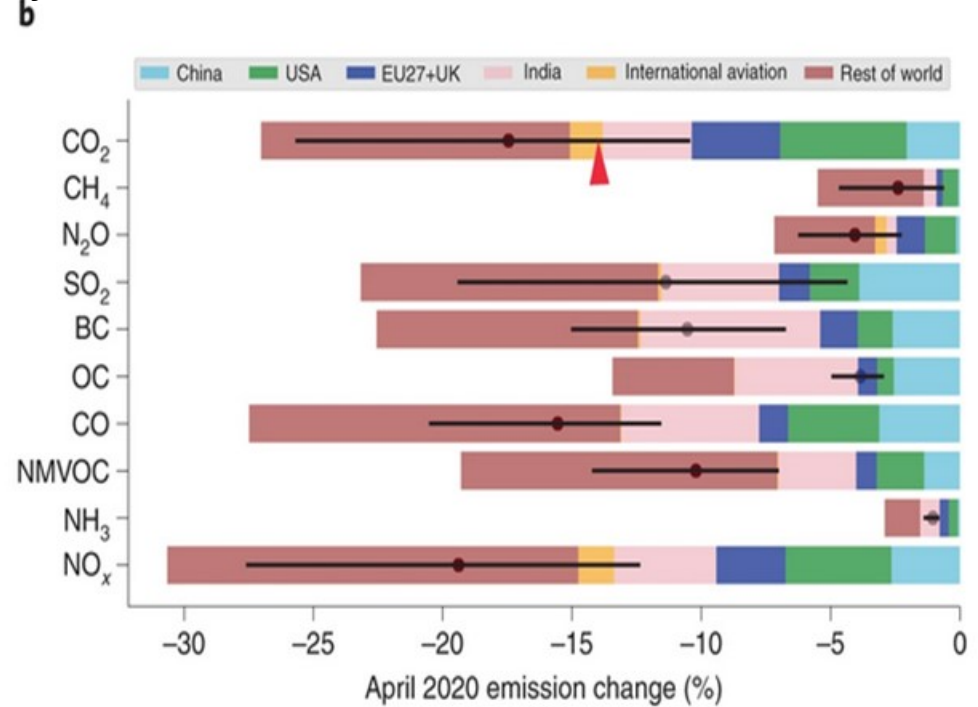
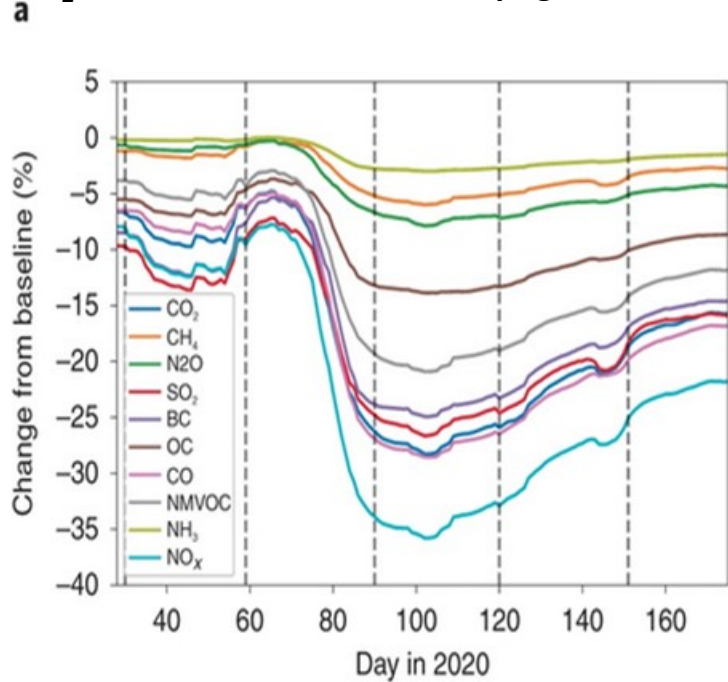


Source: Le Quéré et al. Nature Climate Change (2020); Global Carbon Project

MtCO₂ day⁻¹: million metric tons CO₂ daily

Daily Air Pollution Declines Seen in April 2020

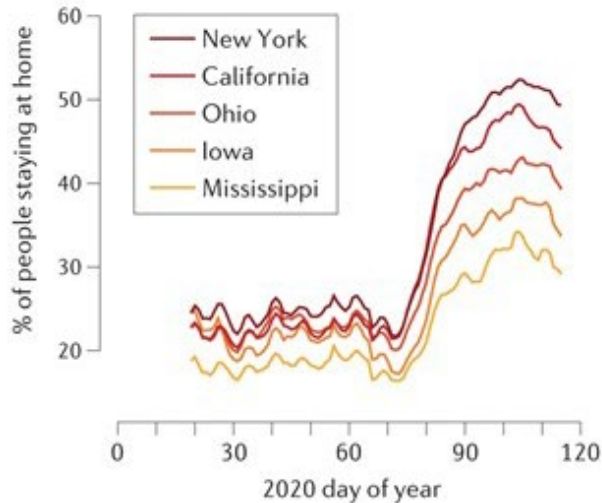
% emission changes for pollutant species as a function of day in the year of 2020. Changes are for fossil fuel CO₂ emissions and total anthropogenic emissions from the other sectors



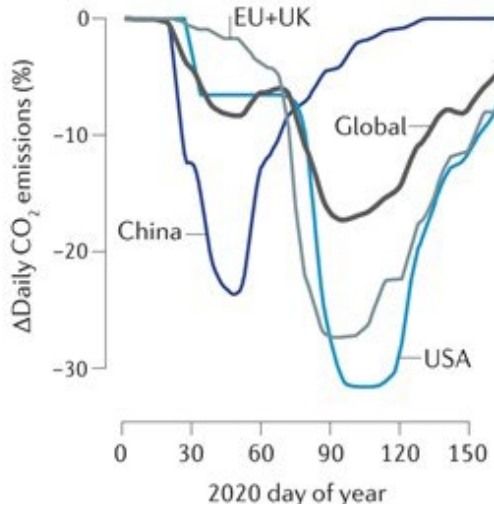
Forster, P.M., Forster, H.I., Evans, M.J. et al. *Current and future global climate impacts resulting from COVID-19*. Nat. Clim. Chang. (2020). <https://doi.org/10.1038/s41558-020-0883-0>

Daily, Cumulative CO₂ Emissions Changes from COVID-19 Sheltering Measures

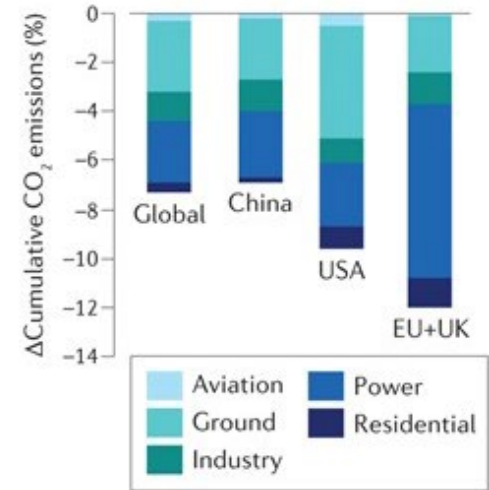
b Sheltering intensity



c Daily CO₂ emissions



d Cumulative CO₂ emissions



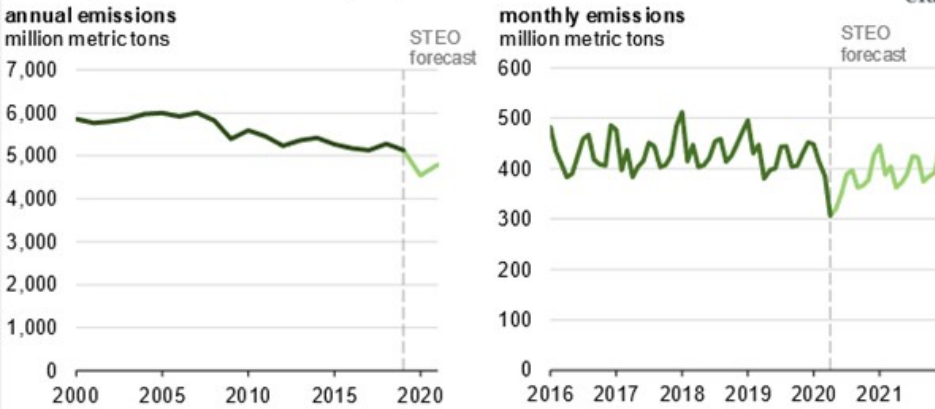
(b) Percentage of people staying at home, as estimated by mobility data from cell phones, for five US states. (c) Percentage change in carbon dioxide emissions for the World, China, the U.S. and Europe. Each day's value is the percentage departure in 2020 from the respective day-of-year emissions in 2019, accounting for seasonality. (d) Percentage change in cumulative carbon dioxide emissions for January through April 2020 compared with January through April 2019 for the World, China, the USA and Europe.

Diffenbaugh, N.S., Field, C.B., Appel, E.A. et al. *The COVID-19 lockdowns: a window into the Earth System.* *Nat Rev Earth Environ* (2020). <https://doi.org/10.1038/s43017-020-0079-1>

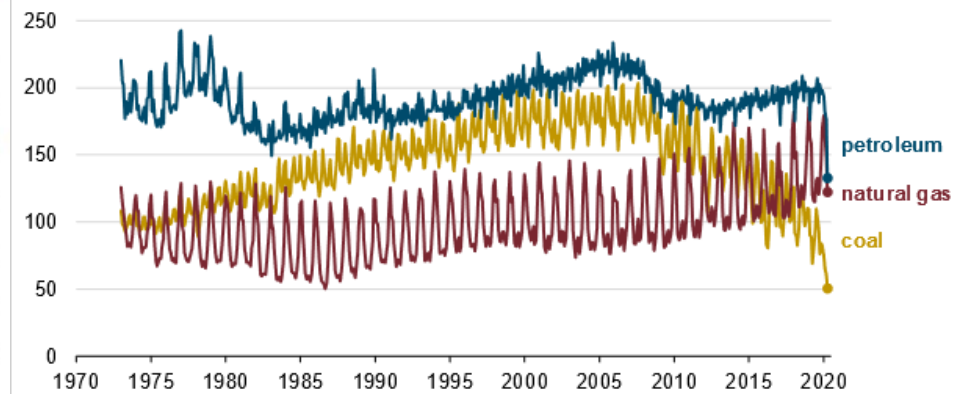
IMPACT OF COVID-19 PANDEMIC MITIGATION MEASURES ON U.S. ENERGY CONSUMPTION

April 2020 U.S. Energy-related CO₂ emissions were the Lowest in Decades

U.S. energy-related carbon dioxide (CO₂) emissions



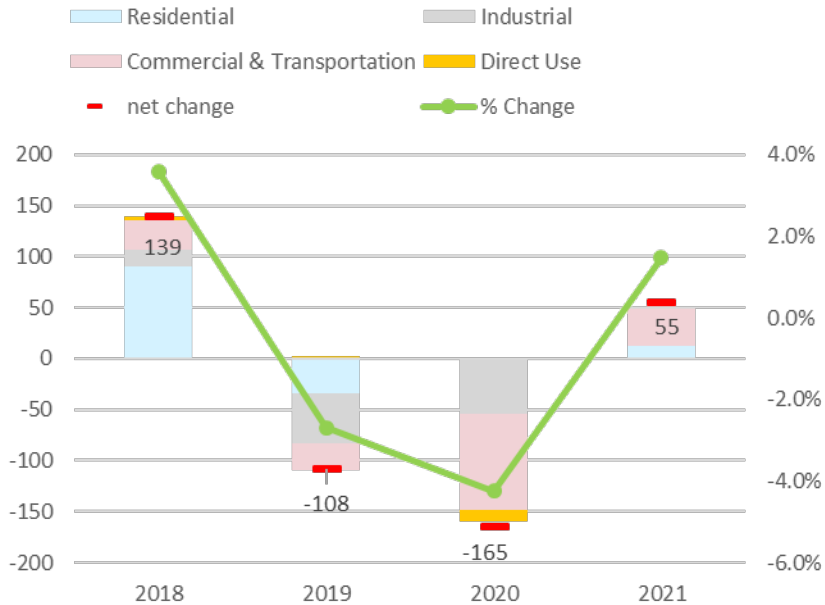
Monthly U.S. energy-related carbon dioxide (CO₂) emissions (Jan 1973–Apr 2020)



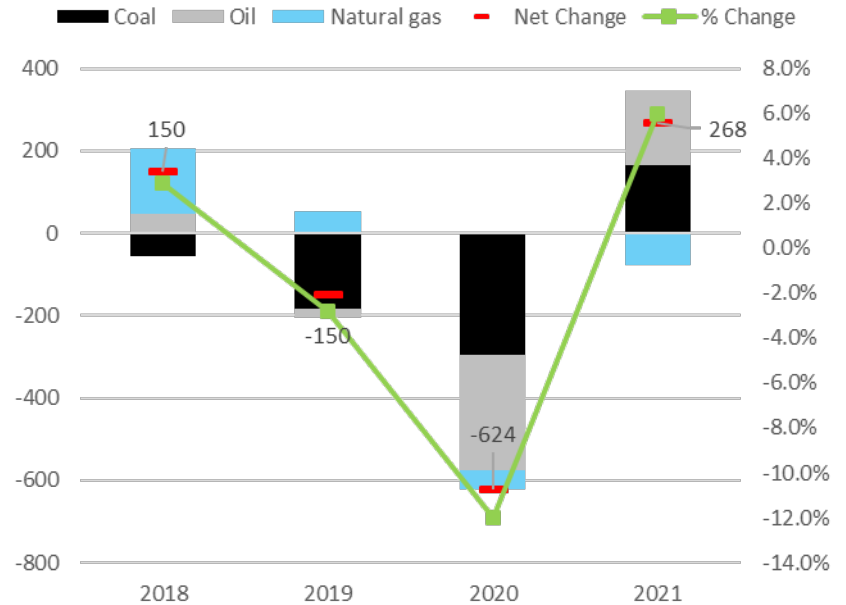
- Travel restrictions and other measures to mitigate the spread of coronavirus in April resulted in sudden and significant changes in energy consumption, resulting in lower energy-related CO₂ emissions in April 2020
- Monthly U.S. energy-related carbon dioxide (CO₂) emissions fell to a record low of 307 million metric tons (MMmt) in April 2020
- The largest decreases in CO₂ emissions occurred in the transportation sector, with CO₂ emissions from motor gasoline consumption (which accounted for 57% of transportation sector emissions in 2019) falling to 59 MMmt
- April 2020 U.S. electric power sector CO₂ emissions were also the lowest monthly levels on record
- Total electricity generation was 7% lower in April 2020 than in April 2019, but energy-related CO₂ emissions were 16% lower
- EIA expects that U.S. energy-related CO₂ emissions will total 4,543 MMmt in 2020, or 11% lower than their 2019 level

COVID-19 Mitigation Measures Impact on U.S. Electricity Consumption & Generation Forecasts

Change in Annual U.S. Electricity Consumption (Billion kWh)



Change in Annual U.S. CO₂ Emissions from Total Energy Consumption (Million Metric Tons)

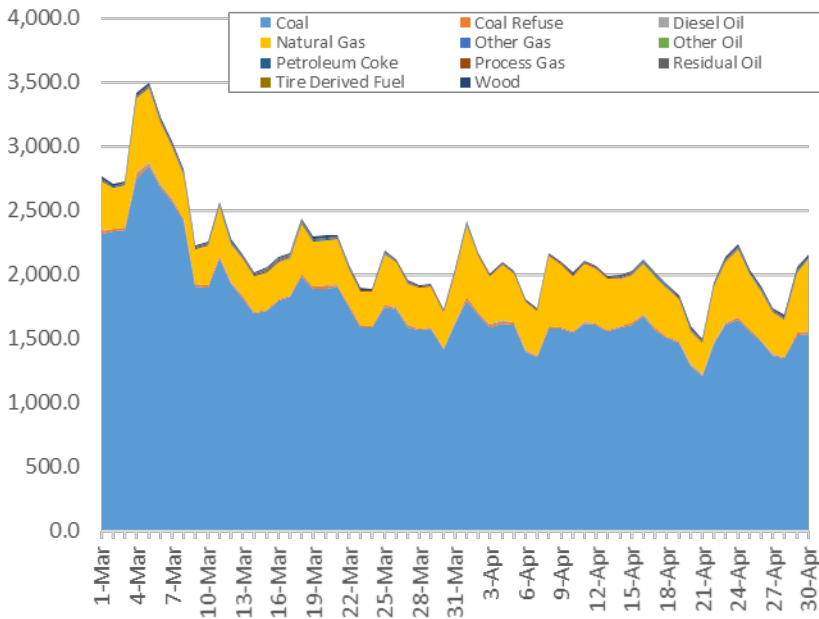


Daily Nitrogen Oxide (NO_x) Emissions from U.S.

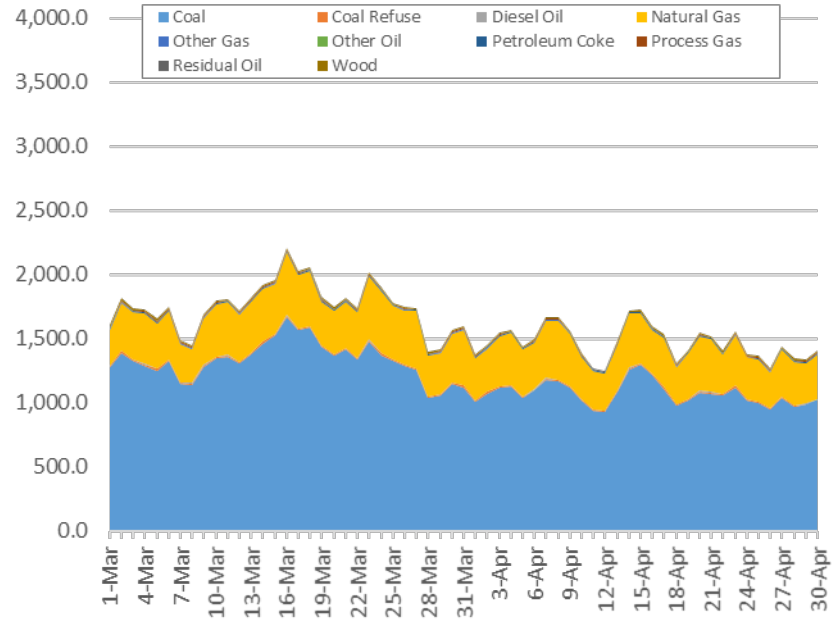
Electric Generation

-26% lower during March – April 2020 vs. 2019, Coal's share declined from 80% to 74%, while Natural Gas's share increased from 17% to 23%

2019 U.S. NO_x Emissions from Electric Generation (Mar-Apr) (Coal 80% share of total)



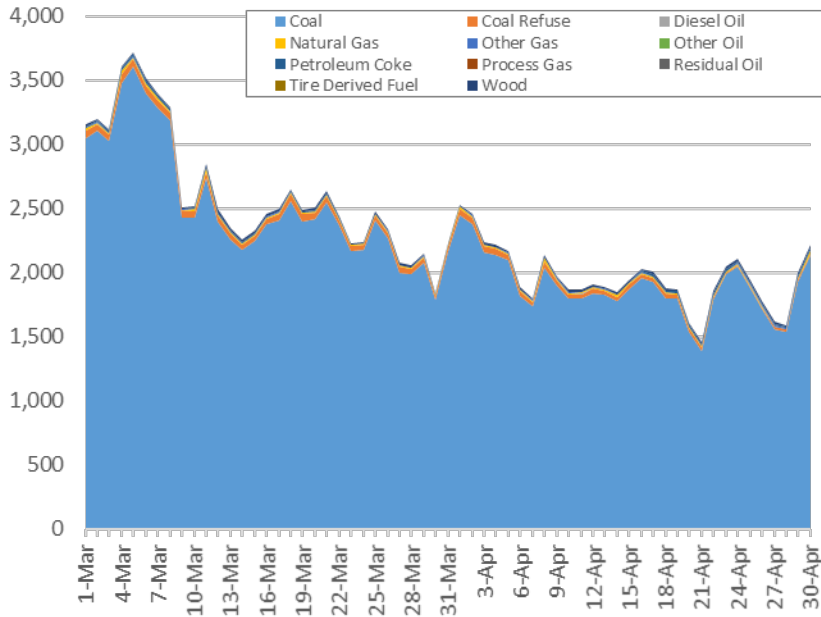
2020 U.S. NO_x Emissions from Electric Generation (Mar-Apr) (Coal 74% share of total)



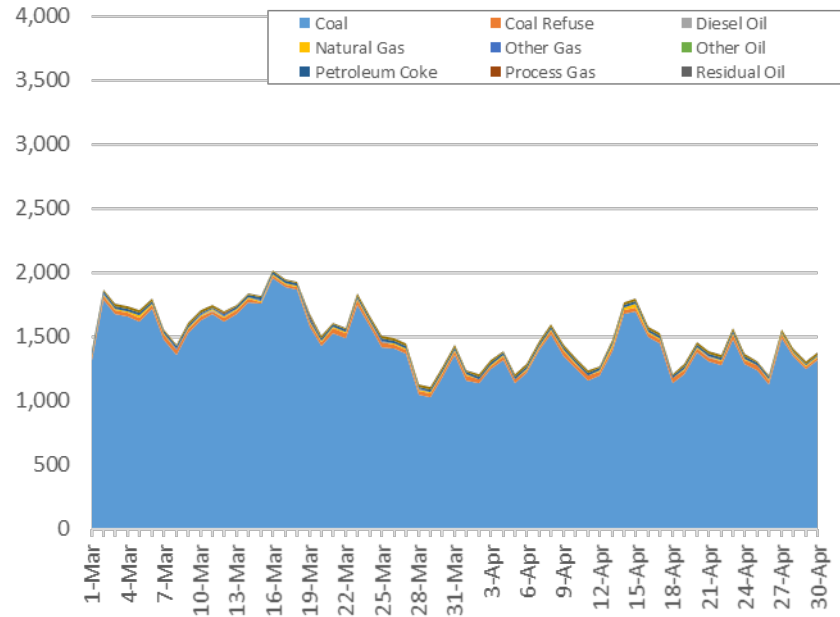
Daily Sulfur Dioxide (SO₂) Emissions from U.S. Electric Generation

-34% lower during March – April 2020 vs. 2019

2019 U.S. SO₂ Emissions from Electric Generation (Mar-Apr)



2020 U.S. SO₂ Emissions from Electric Generation (Mar-Apr)



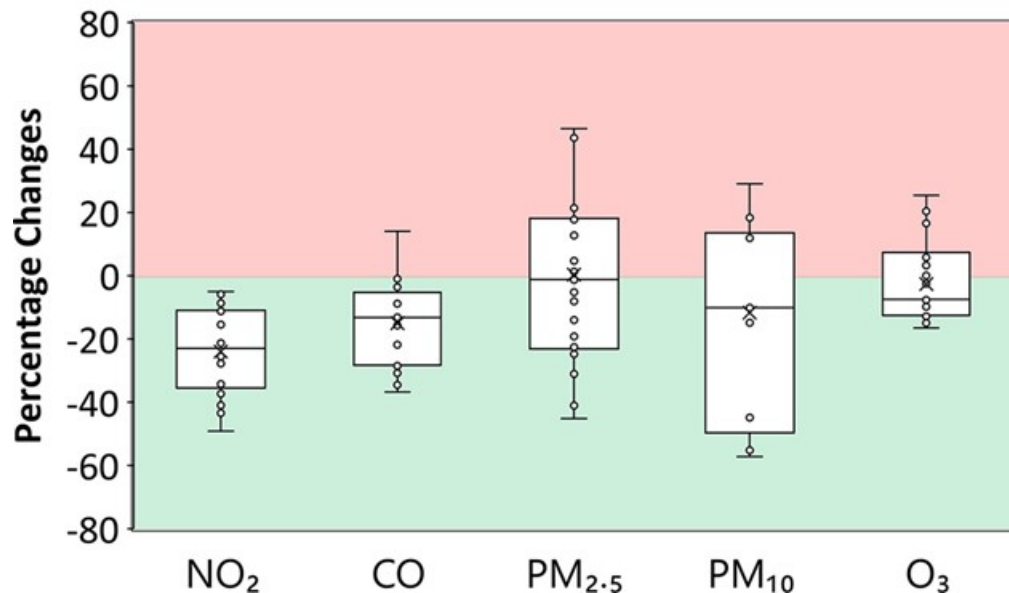
IMPACT OF COVID-19 PANDEMIC MITIGATION MEASURES ON U.S. AIR POLLUTION TRENDS

Air Pollution Declined Across the U.S. Due to COVID-19 Mitigation Measures

Monitoring Sites Saw Lower Concentrations of Pollutants from Cars, Trucks & Power Plants

- Air monitoring data from long-term air quality stations across the U.S. revealed widespread but non-uniform reductions of nitrogen dioxide (NO_2) and carbon monoxide (CO) during the first phase of lockdown (March 15–April 25, 2020) compared to earlier in 2020 and 2017–2019
- Declines in NO_2 (-49%) and CO (-37%) are consistent with lower transportation and utility demands
- EPA attributes 74% of annual total nitrogen oxides (NO_x) and 59% of annual total carbon monoxide (CO) emissions to on- and off-road traffic and electric generation
 - NO_x = sum of nitrogen dioxide [NO_2] and nitric oxide [NO]

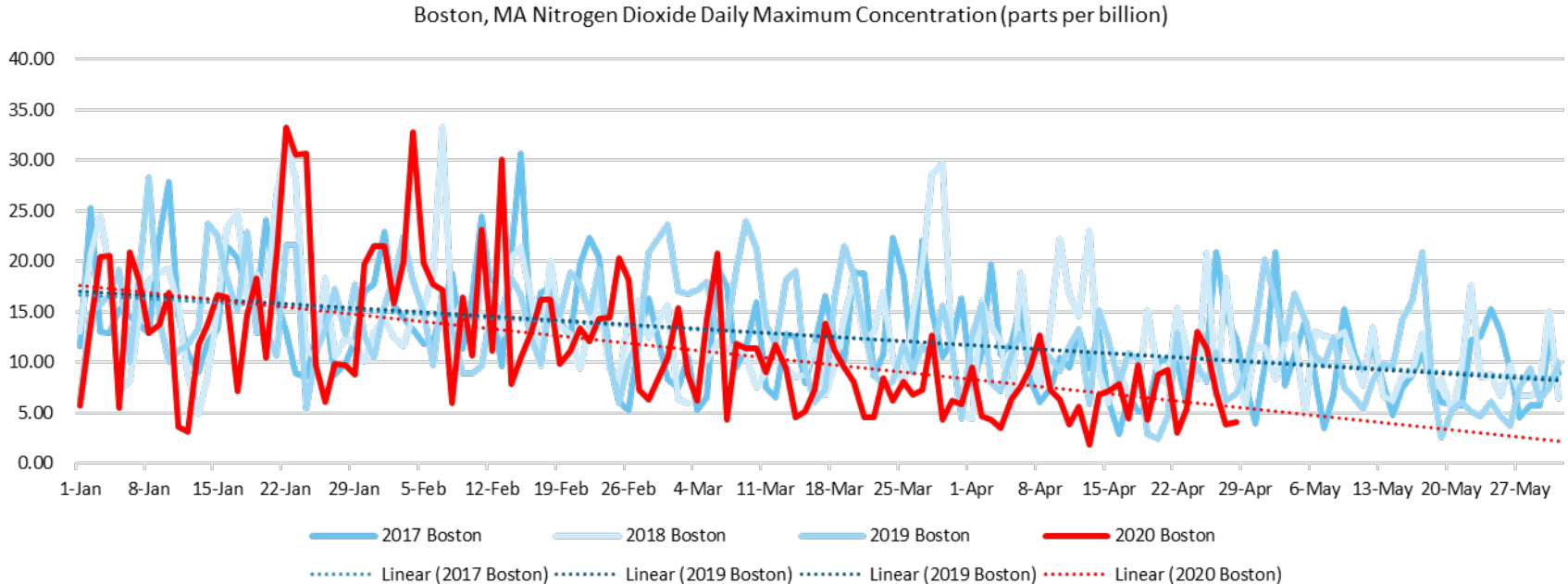
COVID-19 Impact on Air Quality in U.S.



L.-W. Antony Chen, Lung-Chang Chien, Yi Li, Ge Lin, *Non-uniform impacts of COVID-19 lockdown on air quality over the United States*, Science of The Total Environment, Volume 745, 2020, 141105, ISSN 0048-9697, <https://doi.org/10.1016/j.scitotenv.2020.141105>.

NO₂ Pollution Lower in Boston During Pandemic

Measured concentrations -36% lower during 3/15-4/25 compared to Prior Years

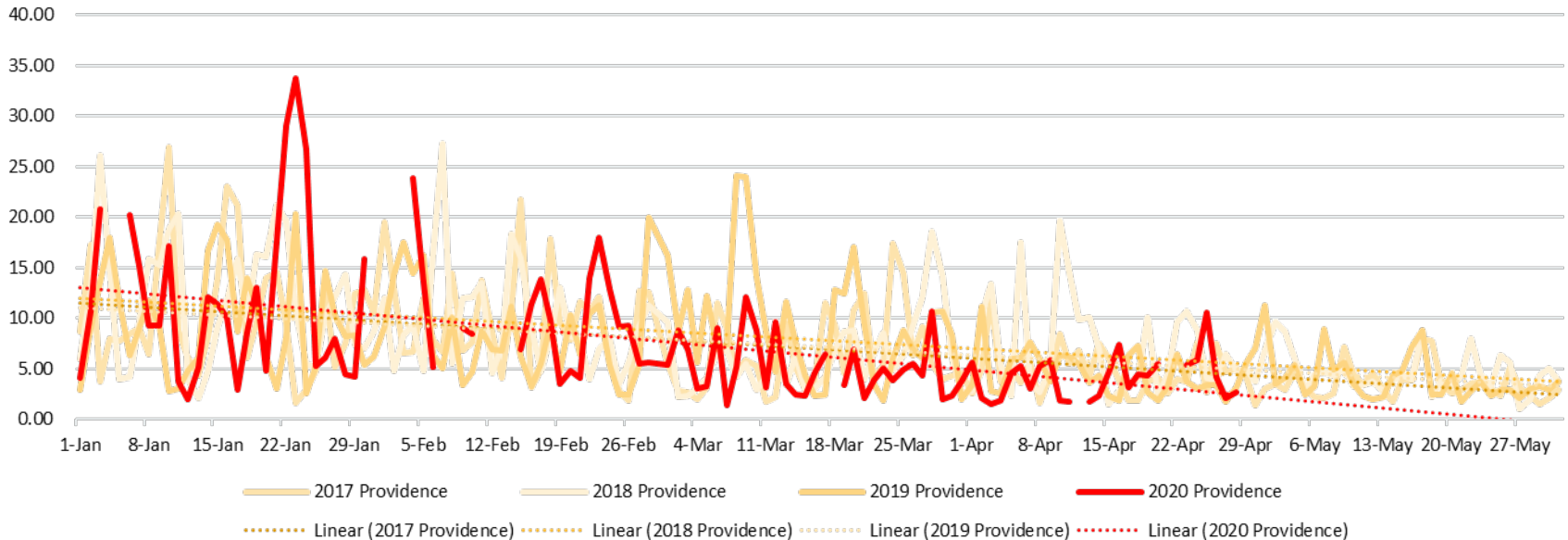


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NO₂ Pollution Lower in Providence during Pandemic

Measured concentrations -26% lower during 3/15-4/25 compared to Prior Years

Providence, RI Nitrogen Dioxide Daily Maximum Concentration (parts per billion)



L.-W. Antony Chen, Lung-Chang Chien, Yi Li, Ge Lin, *Non-uniform impacts of COVID-19 lockdown on air quality over the United States*, Science of The Total Environment, Volume 745, 2020, 141105, ISSN 0048-9697, <https://doi.org/10.1016/j.scitotenv.2020.141105>.

REGIONAL ENERGY USAGE TRENDS

New England

Regional Energy Usage Trends

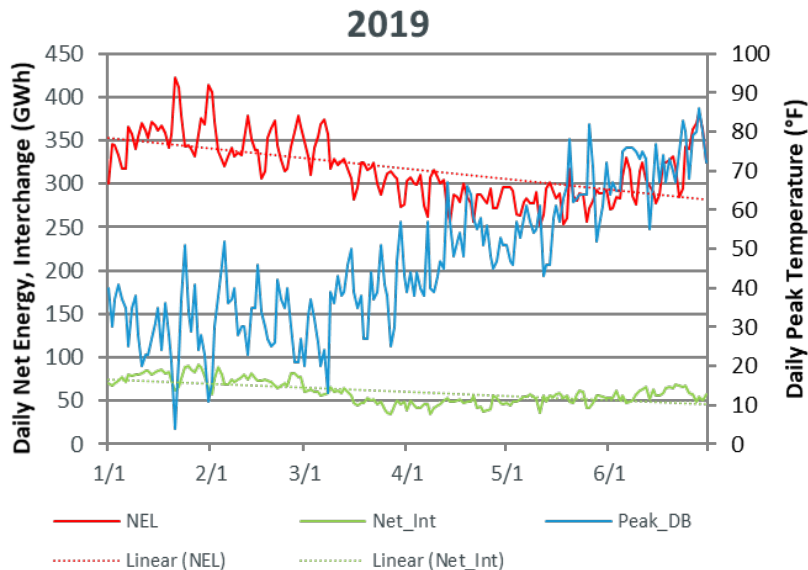
2020 Monthly Energy Usage Trailed Same Month in 2019 until June

- **June 2020:** Energy usage during June increased 4.6% to 9,849 GWh from 9,414 GWh used in June 2019
- **May 2020:** Energy usage declined 6.1% to 8,212 GWh from 8,479 GWh used in May 2019
- **April 2020:** Energy usage during April declined 4.5% to 8,248 GWh from 8,641 GWh used in April 2019
 - ISO estimates COVID-19 pandemic responses resulted in a 3-5% reduction in consumer demand for electricity
- **March 2020:** Energy usage during March declined 7.4% to 9,151 GWh from 9,887 GWh used in March 2019

Comparison of Monthly Demand & Weather Conditions

	Energy Usage (GWh)	Average Temperature (°F)	Average Dew point (°F)	Heating/Cooling Degree Days (HDD/CDD)
Mar-19	9,887	36	45	272
Mar-20	9,151	41	41	271
Apr-19	8,641	49	36	488
Apr-20	8,248	45	30	612
May-19	8,479	57	45	271
May-20	8,212	57	41	272
Jun-19	9,414	67	55	31
Jun-20	9,849	69	56	67

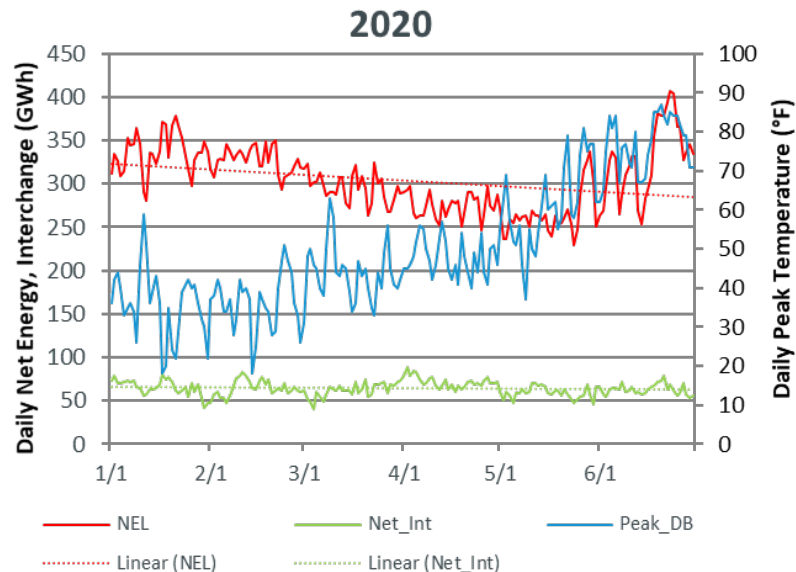
Similar Regional Loads, Weather in in 2019, 2020



Net Energy for Load (NEL): metered daily total New England net energy for load; sum of net generation and net interchange less demand from pumped storage units (GWh).

Net Interchange (Net_Int): total net interchange with neighboring control areas (GWh).

Peak Dry Bulb (Peak_DB): the dry-bulb temperature in °F at the peak demand hour for the weather station corresponding to the load zone or Trading Hub.



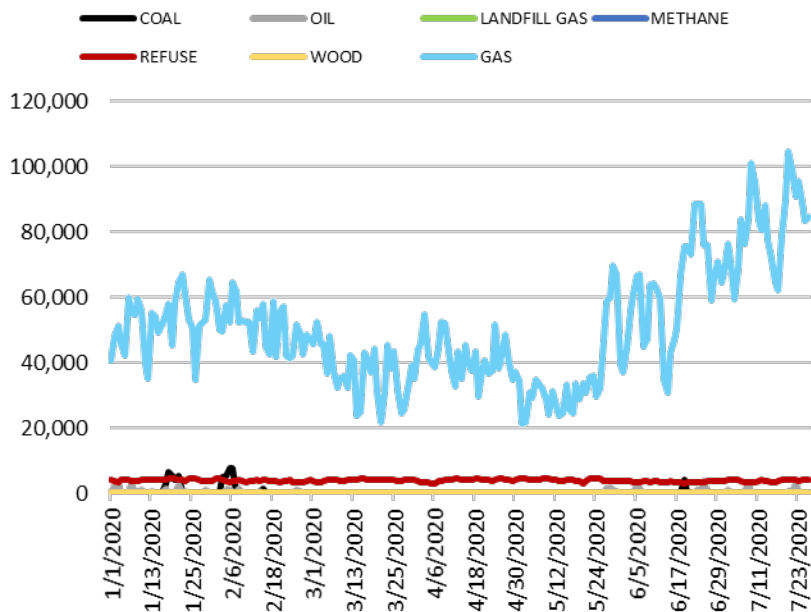
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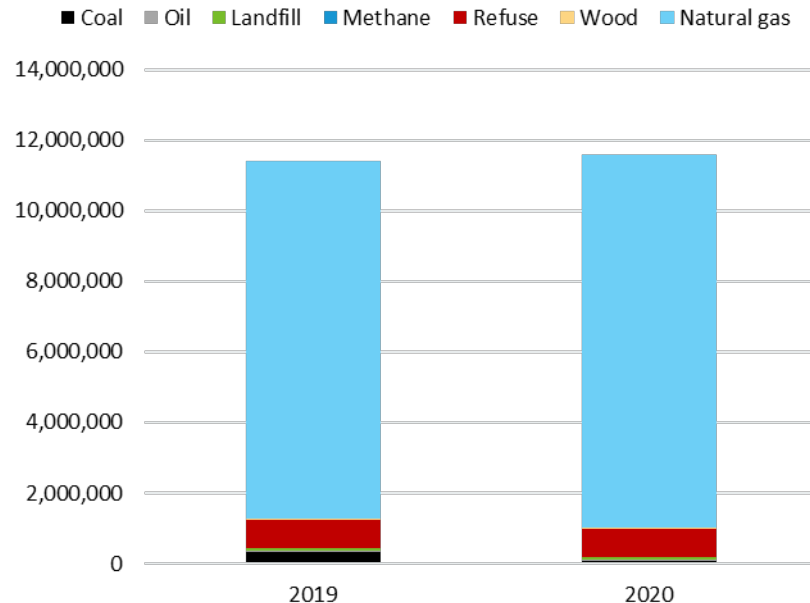
Peak Dry Bulb (Peak_DB): the dry-bulb temperature in °F at the peak demand hour for the weather station corresponding to the load zone or Trading Hub.

2020 Year-to-Date Estimated Electricity Generation CO₂ Emissions by Fuel Type (Metric Tons)

Estimated Daily Native Generation CO₂ Emissions by Fuel Type (Metric Tons)



2019, 2020 YTD Total Estimated CO₂ Emissions by Fuel Type (Metric Tons)



Regional 2020 CO₂ Emissions Summary

- Preliminary estimates indicate economy-wide CO₂ emissions fell ~28-34% across New England states, between March and June 2020
- Decline in transportation activity across New England reflected in lower regional economy-wide CO₂ emissions
 - Transportation CO₂ emissions are 44% - 56% of individual state economy-wide emissions across the region
- New England native electric generation estimated CO₂ emissions increased ~1.4% in the 1st half of 2020 compared to 2019
 - Electricity generation CO₂ emissions are 1-16% of individual state economy-wide emissions across the region

Outlook of COVID-19 Impacts on Environmental Performance of Regional Power System

- Since COVID-19 mitigation responses were implemented in March 2020, ISO has observed loads trending lower than normal, fluctuating from week to week (<1% - 5%)
 - ISO is publishing [weekly reports](#) on the estimated impact of COVID-19 pandemic responses on electricity demand
- The Boston Federal Reserve estimates regional unemployment could increase to 18% in the 2nd half of 2020 (23% nationally) in a moderate case, while a best case scenario sees regional unemployment declining to 11% (14% nationally), declining economic activity could lower demand, and system emissions, as natural gas is the predominant generating fuel in New England
- Available regional economic and energy demand forecasts suggest consumer demand for energy could decline over the next several months, however, the environmental impact of regional electricity demand is sensitive to weather, fuel prices and fuel mix

Questions

