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ESTIMATING U.S. ENERGY DEMAND AND EMISSIONS IMPACTS OF COVID-19 WITH THE ENERGY POLICY SIMULATOR

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COVID-19 has had devastating global public health and economic effects, and the associated climate implications are only starting to become clear. Due to significant uncertainty, few estimates exist of emissions impacts. Those that do exist vary from projecting as low as a 0.5 percent drop up to an 8 percent drop globally for 2020.[1] Meanwhile the United States' energy system is already seeing obvious effects.

U.S. petroleum consumption is at its lowest point in decades due to shelter-in-place orders. Electricity demand has fallen steeply, although it's difficult to disentangle the effects of COVID-19 versus an unusually mild winter. Declines in electricity demand vary by region, for example New York City has seen a 14 percent decline from its pre-COVID-19 average, while the Mid-Atlantic region as a whole has only seen a roughly 5 percent decline.[2]

Moving forward, the implications of COVID-19 on U.S. energy demand and emissions will hinge on national and regional responses, as well as the evolving economic outlook. To explore these future scenarios, Energy Innovation has developed the ability to simulate recession impacts in the U.S. Energy Policy Simulator (EPS). This non-partisan, open-source, and peer-reviewed model uses government data to assess the impacts of dozens of energy-related policies on emissions, costs and savings, and fuel consumption. While the new feature can only very roughly capture COVID-19 impacts, it allows users to assess how various U.S. GDP trajectories may affect sectoral energy demand and emissions at a general level.

This research note compares EPS outputs across three different GDP outlooks and finds that short-term emissions are dependent on the severity of COVID-19 impacts, with 2020 U.S. emissions reductions ranging from 7 to 11 percent relative to 2019. However, emissions will likely approach pre-COVID-19 levels by 2025 and COVID-19 is not likely to have a material impact on annual emissions in 2030 or cumulative emissions through 2050.

[1] The only comprehensive, U.S.-focused analysis we are aware of at the time of publication is EIA's April Short-Term Energy Outlook.

[2] In addition to overall reductions in demand, very low natural gas prices are changing the dispatch order of power plants in certain regions, which also contributes to changes in emissions from electricity.

LINKING GDP IMPACTS TO ENERGY DEMAND

The current period of widespread shelter-in-place orders uniquely complicates forecasting COVID-19 impacts based on how U.S. energy demand previously responded in the face of economic shocks. For example, commercial building energy use declined by only a small amount during the Great Recession, but office buildings are now shuttered across the country. Similarly, current restrictions are impacting transportation in new and profound ways, and the lingering effects once shelter-in-place measures start to lift are still unknown.

The Energy Information Administration's (EIA) Short-Term Energy Outlook, which reports metrics such as energy demand and GDP though 2021, incorporates COVID-19 into its latest projections and allows us to estimate the sensitivity of sectoral energy demand to changes in GDP.[3]

Several organizations have released GDP projections, and these outlooks are rapidly evolving. For example, the International Energy Agency (IEA) reports that every month of containment measures may decrease expected annual GDP by more than 2 percent. Rather than produce our own estimate of GDP impacts, this analysis explores a range of possible GDP impacts published by other institutions. In addition, the online version of the Energy Policy Simulator, available at https://us.energypolicy.solutions, allows any user to test their own range of possible GDP impacts, including different timeframes for economic recovery.

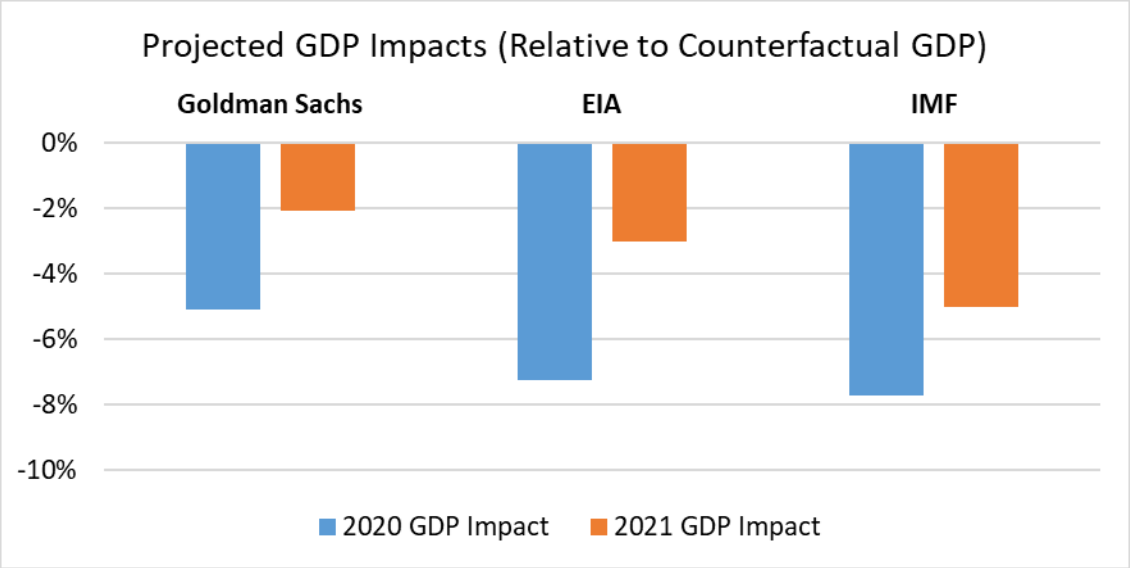
In order to explore different GDP projections and the corresponding impacts on energy and emissions, we built a quantitative relationship between GDP impacts and sectoral energy demand (and fuel imports/exports) into the EPS. This quantitative relationship allows us to estimate how various economic outlooks affect sectoral energy demand, which then feed through the rest of the model's calculations and outputs.

EVALUATING THREE EXAMPLE CASES

To test a range of outlooks, we used the quantitative relationship between GDP and changes in energy use described above with three different GDP outlooks in light of COVID-19. Each of the three sources, Goldman Sachs[4], EIA, and the International Monetary Fund (IMF), provide GDP estimates through 2021. We assume a tail on GDP impacts based on the ratio of 2020 impacts to 2021 impacts, where we apply the same ratio in each successive year after 2021 until projections return to baseline.

[3] For industry and buildings, the Short-Term Energy Outlook reports sectoral changes in electricity, coal, and natural gas demand, which we use to calculate an overall percentage change in energy demand. For transportation, we use change in vehicle miles travelled as a proxy for energy demand.

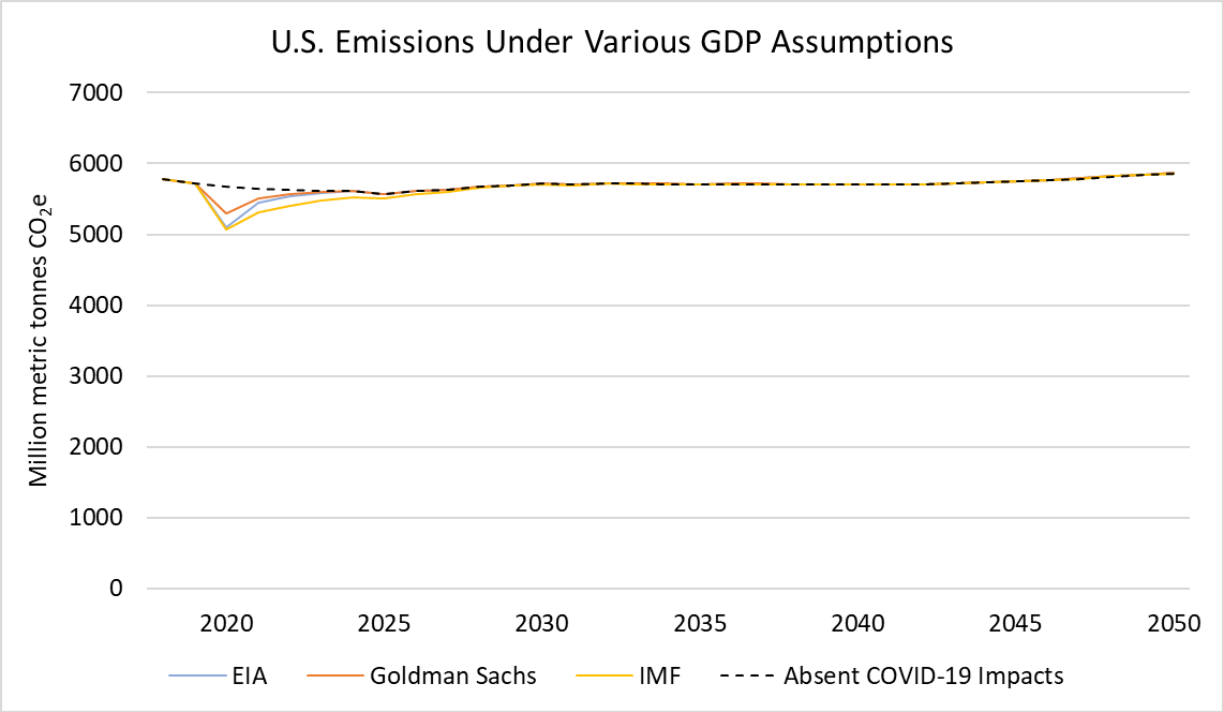
[4] Data as of March 20, 2020.



The sudden drops in GDP result in sharp decreases in 2020 energy demand across the economy, shown below.

	Absent COVID-19 Impacts	Goldman Sachs Case	EIA Case	IMF Case
Million Metric Tons CO_2e Emissions	5,681	5,294	5,100	5,071
Trillion Freight Ton-Miles Traveled	11.4	10.5	10.1	10.1
Trillion Passenger-Miles Traveled	6.2	5.7	5.5	5.5
Industrial Energy Demand (trillion BTUs)	19,883	18,688	18,149	18,068
Residential Energy Demand (trillion BTUs)	11,056	10,870	10,786	10,773
Commercial Energy Demand (trillion BTUs)	9,360	8,978	8,805	8,780
Electricity Generation (TWh)	4,088	3,939	3,872	3,862

The three cases result in different emissions profiles depending on the severity of the GDP shock. The 2020 impact on emissions of carbon dioxide equivalent (CO_2e) vary from 7 to 11 percent below 2019 emissions.



In each case, the emissions reduction is dominated by decreased transportation, as transportation demand is twice as sensitive to COVID-19 impacts as commercial building and about thirty percent more sensitive than industry. The remaining emissions reductions are driven by lower demand in industry, electricity generation,[5] commercial buildings, and finally residential buildings.[6]

CONCLUSION

The path to economic recovery in the face of COVID-19 is still uncertain, and the U.S. response will undoubtedly have a profound effect on short-term energy demand and emissions. Any attempt to exactly map the implications will likely suffer from false precision, but the EPS is a powerful tool to understand what sectoral changes in energy demand may look like at a high level. We project that the impact to 2020 GDP will have a strong influence on 2020 emissions, but emissions are likely to rebound to pre-COVID-19 levels well before 2030, and the short-term emissions impacts from COVID-19 will not make a material difference on cumulative emissions to 2050.

[5] It is worth noting that this analysis does not attempt to represent recent fuel price fluctuations given significant uncertainty about the global oil outlook. Electricity sector emissions will be sensitive to the relative difference between coal and natural gas dispatch prices.

[6] Residential electricity demand has increased in at least some parts of the country due to shelter-in-place measures. However, EIA's Short-Term Energy Outlook reflects marginally lower residential electricity and natural gas demand, which may be influenced by the unusually mild winter.