There has been no shortage of commentary on what the Coronavirus pandemic means for climate action and for the energy industry. Obviously, it is too early to draw firm conclusions, but the last several weeks have made clear that the crisis is affecting the entire energy economy in profound ways and that our collective response to these changes will determine a great deal about the makeup of our future energy system and our ability to fight climate change.

Impacts on Fossil Fuels

On Monday of this week, the West Texas Intermediate (WTI) benchmark price of crude oil for May delivery closed at *negative* $37.63 a barrel, down from $18.27 per barrel on Friday. Coming near the end of the May contract (which closed on Tuesday), the negative futures contract price served as dramatic marker of the stunning collapse of oil markets caused by the Coronavirus. Over the last few weeks, global oil demand has declined by roughly 20 million barrels per day (about 20%). Expectations are that demand will fall another 10 million barrels per day. This unprecedented demand shock has been further compounded by an inability to curtail supply, first as a result of Saudi Arabia's efforts to take market share in its spat with Russia and then as a result of the inadequate OPEC deal to cut production (about 10 million barrels per day). This has left producers struggling to find places to store their oil, with some moving to shut in wells.

As has been widely reported, the lack of available storage to put all of the excess oil sloshing around the world is one of the main proximate factors driving the collapse in prices. While Monday's negative price effectively meant that sellers were willing to pay buyers to take their oil for May delivery, the June contract was trading at around $14 per barrel on Wednesday and the September and October contracts were over $25, reflecting the general view that as the pandemic eases demand for oil will rise again. With many hoping to profit off stored oil when prices do rise again, daily storage rates for massive oil supertankers and other facilities have risen significantly. The image of supertankers traveling listlessly across the high seas waiting for a port of entry when oil prices rise again serves as a poignant reminder of the huge global infrastructure dedicated to servicing our addiction to oil.

While the longer term implications of all of this for the oil industry are still unclear, a few points are worth emphasizing. First, some analysts are predicting that we have now passed the point of peak oil. Projected to happen in the mid- to late-2020s (and a topic of vigorous debate for decades), global oil consumption, according to these analyses, may never rise beyond the level it achieved in 2019. If that is true, we

have bent the curve and will be on the downhill slope of declining global oil production coming out of the pandemic. The slope of that curve will determine much about how quickly we can reduce global greenhouse gas emissions.

Second, the US shale oil industry is being decimated. Rig counts are way down and production is declining. The average breakeven price for US shale oil producers is around $50 per barrel. Most producers need prices of around $35 per barrel in order to make interest payments. The pandemic and the collapse in oil prices has made clear that the U.S. shale boom was driven by a binge on cheap debt made available in the wake of the 2008 financial crisis. With lots of small and mid-sized companies taking on huge amounts of high-yield corporate debt, they had an incentive to keep drilling new wells in order to secure more capital to service that debt. This was unsustainable even before the crisis, with bankruptcies already up 50% in 2019. Now, expectations are that absent a massive intervention by the federal government we will see a wave of new defaults across the sector. Last week the Federal Reserve initiated a program to buy junk bond ETFs as part of its effort to prop up corporate debt markets. Given that a significant portion of this debt is held by U.S. shale oil producers, this should benefit some of those companies. But it will not be enough, which is one of the reasons why President Trump has asked the Treasury Department to develop a plan to rescue the oil industry. The reactions of Big Oil to all of this will be important to watch closely. Exxon, BP, Shell, Chevron, and other large companies could actually benefit from a shakeout among smaller players that could help them to consolidate the industry.

Third, as the domestic shale industry collapses, the geopolitics of the global oil industry have shifted again, but this time in ways that likely will not favor the United States. If we emerge from the crisis more dependent on foreign oil than before, we should think twice about the energy security arguments in favor of increasing domestic oil production at the expense of transitioning away from oil.

Overall, we are witnessing a massive devaluation of capital in the oil industry. How far it goes, how long it lasts, and what happens after the pandemic subsides will have a huge impact on how rapidly we can transition to clean energy. Obviously, this has implications for large numbers of jobs, both here in the U.S. and globally. Analysis by IHS Markit indicates that the shale industry in the U.S. accounts for some 2.5 million jobs. Direct employment in oil and gas extraction is around 155,000 jobs. Many more are employed in ancillary and related sectors. Finding ways to support and provide new jobs for these workers as part of a clean energy transition will be critical.

It is always dangerous to bet against Big Oil. The current crisis will almost certainly lead to further consolidation in the industry and a relative strengthening of the large multinationals and the big state-owned oil companies compared to small and mid-size players. On climate change, some of the largest oil companies are changing their tune, with Shell and BP announcing recently that they will go carbon neutral by 2050. But actions speak louder than words, and the historical record provides little reason to trust the oil companies, especially on climate change. One big question coming out of the pandemic is whether the crisis will allow the rest of us to see a world beyond oil and move toward it on our terms – not those of the oil companies. Needless to say, the politics of this will be fierce, both here in the US and around the world.

Other fossil fuels are also suffering. Natural gas prices have declined as a result of coronavirus, but not by much, as they were already quite low after years of oversupply. Prices in the U.S. are now back up close to where they were before the crisis—slightly less than $2.00 per MMBtu. Here the picture is more complicated on both the supply side and the demand side. In the U.S., around 40% of natural gas production is "associated gas"—that is, gas that is produced as a byproduct of the production of oil. As oil production declines, gas supplies also decline. Additionally, natural gas is not as vulnerable to the demand shocks that oil has experienced. While commercial and industrial demand for natural gas has decreased, much of the natural gas in the United States is used to generate electricity and for heating and cooking. These activities have not experienced the substantial declines that various forms of transportation have, which has been the main driver in the collapse of oil demand. For all of these reasons, investors and analysis in the U.S. see a tightening market for natural gas over the next year, with higher prices taking hold next winter. Of course, in the age of Coronavirus, any projections about what will happen six months from now must be taken as highly speculative.

As for coal, it continues to get hammered. The overall reduction in electricity demand of between 5 and 15% across the country (with significant regional variation) and shifting load curves as a result of the economic shutdown have led to further declines in electricity prices that have hurt coal-fired generation more than any other source. Between mid-March and mid-April, coal-fired generation suffered a record decline, falling to around 16% of total U.S. power demand. The Energy Information Administration's most recent short-term energy outlook estimates that coal generation will fall by 20% in 2020, with natural gas generation rising by 1%, and renewables rising by 11%. Over the past six weeks, wind has generated more

electricity across the U.S. than coal on three separate days. That fact alone marks a stunning reversal of coal's previous dominance, and some are questioning whether the coal industry can survive the coronavirus.

Indeed, despite EPA's efforts to throw yet another lifeline to the coal industry with the revision of the legal findings supporting the Mercury and Air Toxics Standards (which is really a battle over the use of co-benefits), the industry is dying faster than it was before the crisis. Two weeks ago, the Georgia Environmental Protection Division denied the last permit for a new coal plant in the United States. Jobs in the domestic coal mining industry, which stood at roughly 50,000 before the pandemic, have been in steep decline for years, with many coal operators filing for bankruptcy. As with the oil industry, creating meaningful transition relief for these workers and their communities as part of the ongoing clean energy transition will be imperative.

Impacts on Clean Energy

But what about the other side of the energy business – the clean energy side. The impacts here are also mostly negative, but not nearly as bad as they have been for oil and coal. As in other sectors of the energy economy, renewable energy finance is suffering as capital markets have seized up. Projects have been delayed or abandoned. Supply chains have been disrupted. Jobs are being lost.

One recent survey found that 80% of clean energy companies have stopped or delayed previously announced projects. Demand for tax credits dedicated to renewable energy has all but dried up, leading clean energy advocates to push for changes to the tax credit provisions – including, extension of deadlines and moving to cash grants – along the lines of what happened after the 2008 financial crisis.

Job losses in the clean energy sector are also increasing. More than 100,000 workers lost their jobs in March, with expectations of total job losses of a half million workers (about 15% of the clean energy workforce).

Analysis by the American Wind Energy Association (AWEA) in March indicated that the coronavirus pandemic has put 25 gigawatts of wind power and $35 billion in investments at risk, which could lead to a loss of over 35,000 jobs in the wind industry alone (out of a total of around 145,000 workers in 2019).

The Solar Energy Industries Association (SEIA) has estimated that more than half of

the industry's total workforce of 250,000 is at risk as a result of the coronavirus.

As noted above, however, renewable electricity generation from wind and solar is expected to continue growing in 2020, though not as fast as before. In the U.S., the Energy Information Administration (EIA) expects that the electric power sector will add 19.4 gigawatts of new wind capacity and 12.6 gigawatts of utility-scale solar capacity in 2020 (representing capacity additions that are 5% and 10% lower, respectively, than projections from before the pandemic).

Globally, new wind and solar capacity growth is expected to slow down, with one analysis indicating an 18% decline in new solar PV capacity relative to 2019. But that is after years of record growth, and expectations are that renewable capacity will continue to grow overall and as a percentage of global power supply.

In sum, while the coronavirus has certainly slowed the growth of renewables, it does not appear to have derailed that growth.

The move to electrify transportation and other sectors has also slowed. Wood Mackenzie is forecasting a more than 40% decline in EV sales in 2020 (a reduction from more than 2.2 million vehicles sold in 2019 to 1.3 million in 2020). Investments in EV charging infrastructure are being pared back. And the Trump administration has rolled back the Obama administration's tailpipe emissions standards for CO_2.

But analysts seem to agree that although the coronavirus will slow the EV transition, the direction of travel will not be affected. And, of course, the 2020 election could give all of this a big boost. Even before the coronavirus, Joe Biden was calling for half a million new EV charging stations to be built by the end of 2030.

Last Best Chance for a Green Recovery?

The reduction in global emissions from the economic shutdown over the last month is expected to be globally significant, more than 5 percent according to one estimate. Transportation emissions, which are the largest source of emissions in the U.S., have gone way down. The big question coming out of this is whether we will seek to get back to "normal" by reopening our economies and restoring economic growth as quickly as we can, in which case emissions are expected to bounce back close to where they were before the pandemic, or whether we seize the opportunity

to build a more sustainable, fair, and resilient economic system.

If we are finally going to get serious about climate change, trying to get back to "business as usual" is not an option. In order to even have a chance of keeping warming below 1.5 degrees C and avoid the worst impacts of climate change, we need to be reducing global emissions by 7.5% per year every year, starting now. The Coronavirus experience thus stands as an important lesson for just how hard it will be to do that. If we fail, the loss of life and livelihoods that we can expect to witness is staggering—far beyond anything we have seen from Coronavirus. As the climate emergency intensifies, the impacts won't simply go away in a matter of months or years. The stakes are much higher with climate change than with Coronavirus.

Put another way, we simply cannot afford to wait for meaningful climate action while the economy recovers from this crisis. While it is undeniably true that the current crisis is a terrible way to reduce greenhouse gas emissions, it has given us an opportunity to accelerate the transition to clean energy and to decarbonize faster than we would have in the absence of the pandemic.

Actions by the Federal Reserve and other central banks have injected an unprecedented amount of money into the global economy. Capital will be very cheap for the foreseeable future. Channeling that capital in ways that will accelerate the clean energy transition seems like an obvious and wise course of action. Before the crisis, some central bankers were starting to talk about ways to green macro-finance. Now is the time to accelerate those efforts in a coordinated manner.

As Governments around the world turn to rebuilding their broken economies, the case for green stimulus is gaining. A majority of climate and environment ministers from European nations have called upon their governments to put the European Green Deal at the center of the EU's Coronavirus response. Here in the United States, hardly a day goes by without yet another call for a green stimulus, perhaps as a step toward the ambitious Green New Deal.

Demands for austerity will surely come roaring back once the initial wave of the pandemic subsides. And the extreme polarization that continues to afflict U.S. politics will make it very challenging to push this agenda forward. Last month, the Democratic leadership in the House and Senate were openly mocked by Senator McConnell, President Trump, and other voices on the right for even floating the idea

of using stimulus funds to support the clean energy transition, as if the climate crisis can be kept in a box and put away for later. As the House leadership gears up for yet another package of coronavirus relief, this time with a focus on state and local governments, early indications suggest that meaningful green stimulus provisions will, one again, have to wait.

But given the massive destruction of capital that is ripping through the world oil industry, the fact that both oil and coal are in long-term secular decline around the world (despite the fact that, as my colleague Alex Wang points out, China's appetite for coal continues to grow), and the substantial and growing popularity of clean energy, it seems obvious from a purely economic standpoint that a focus on clean energy as part of any economic recovery plan is the best use of taxpayer dollars. Add to all of that the urgency of avoiding the worst impacts of climate change, and the case for a green stimulus is easily made.

Advocates on all sides are clearly marshalling their forces to position their respective industries to capitalize on the unprecedented amount of government assistance that is being made available to respond to the economic impacts of the Coronavirus. The great challenge over the coming weeks, months, and years is whether we can mobilize the political will to double down on the clean energy transition and (re)build a global economy that will be more resilient, more fair, and more sustainable.