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Mapping Low-Carbon Energy Transitions Around the World:
The United States of America

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0. SUMMARY

Greenhouse gas emissions in the United States in 2017 were 13 percent below their level in 2005, the base year for the U.S. Nationally Determined Contribution (NDC) under the Paris Agreement. In 2018, emissions are believed to have risen somewhat, but official government data are not yet available.

Energy use has been falling in the United States, even as the economy has grown. In the last decade, energy use fell 1.7 percent while GDP grew 15.3 percent. In the primary energy mix, fossil fuels declined from 85 percent in 2007 to 80 percent in 2017, while renewable energy (including large hydro) grew from 6 percent to 11 percent. The carbon intensity of the fossil fuel mix declined, with a significant shift from coal to natural gas.

Economics, rather than policy, has been the primary driver of the U.S. emissions decline. The majority of the decline is in the power sector, where advances in domestic natural gas production brought very low prices, allowing natural gas to outcompete coal in power generation. As a result, coal's share of the generation mix dropped 40 percent and the share of natural gas rose 46 percent over the last decade. Additionally, the share of non-hydro renewables nearly quadrupled over the same time period. U.S. power sector emissions declined 25 percent over the last decade.

Despite this progress, the United States is not on track to meet its NDC. According to some projections, U.S. emissions in 2025 will only be 12 to 20 percent lower than the 2005 levels, falling far short of the target of 26 to 28 percent. The Trump administration is rolling back policies, including those regulating power plants and vehicles, put in place by the prior administration to meet the NDC targets. Furthermore, the Trump administration has announced its intent to withdraw from the Paris Agreement in late 2020, as soon as this withdrawal is allowed. The NDC is not a driver of current policy and the Trump administration is not introducing new policies to reduce U.S. greenhouse gas emissions or further a low-carbon energy transition.

However, the states have more jurisdiction in the power sector, and policies in many states require or encourage low-carbon power. Moreover, following the announcement that the U.S. would be withdrawing from the Paris Agreement, coalitions of state and local governments, business and civil society organizations – such as the "We Are Still In" coalition – formed, with pledges to continue efforts to reduce emissions in line with the goals of the Paris Agreement. A study has shown that if cities and states undertake ten high-impact and readily available opportunities, U.S. emissions could be brought down to 21% below 2005 levels by 2025. The federal level, nevertheless, will remain critical, particularly in vehicle efficiency standards, where the outlook is unlikely to change until the federal government does.

1. U.S. CLIMATE POLITICS

In the United States, policy to achieve a low carbon energy transition and mitigate climate change is very politicized. Thus, understanding the path of energy and climate policies requires understanding the underlying politics.

The Republican Party currently holds the presidency and Senate, and it rejects climate science and policy. In the United States, the two main political parties agree upon wide-ranging policy platforms every four years, in advance of the presidential election. The 2016 Republican platform specifically opposes any carbon tax and says it will forbid Environmental Protection Agency (EPA) regulation of carbon dioxide (CO2) as a pollutant. The only mention of climate change is to say that it is "far from this nation's most pressing national security issue" (The Grand Old Party, 2018). The implications of climate change do not fit the worldview of many right-leaning U.S. politicians, so they reject the notion entirely.

In line with the platform he created while running for office, President Trump is systemically dismantling the climate and environmental policies of the Obama administration. However, the roots of this action lie much earlier, in the failure of comprehensive climate legislation in 2009, during the early years of the Obama administration. After that, the Republican Party took over both houses of the U.S. Congress in 2010, effectively ending the opportunity to pass new legislation to deal with climate change.

Instead of legislation, the Obama administration used the mechanisms that it had available: regulation under current law and executive orders. These mechanisms do not require approval from Congress, but they bring about two important negative consequences.

First, regulatory mechanisms are generally less economically-efficient compared to market mechanisms in limiting emissions. The Waxman-Markey bill that failed in 2009 would have capped U.S. greenhouse emissions and established a trading system to allocate emissions. Once that bill failed and Republicans took over Congress, second-best regulatory mechanisms and executive orders were the only tools available, working through existing laws and areas under executive authority. However, these actions do not allow tradeoffs among sectors to find the lowest-cost emissions reductions.

Second, regulations and executive actions are easier to undo than legislation. The president can rescind an executive order with the stroke of a pen, while rolling back regulations is a longer process, requiring the same comment and revision process undertaken to establish a regulation in the first place. Yet both of these processes take place under existing laws, and thus do not require action from Congress. The Trump administration is going through these processes now, with the goal of removing climate policy, and many other environmental policies, root and branch.

In addition to backtracking on prominent regulations that affect greenhouse gas emissions, like the Clean Power Plan and Corporate Average Fuel Economy standards, the Trump administration is implementing changes behind the scenes that impact how climate is considered in regulatory decision-making. One example is the social cost of carbon, an estimate of the economic damage caused by the emission of one ton of CO2. The Obama administration convened an interagency group to estimate the social cost of carbon, which estimated a cost of $42 per ton in 2020. The Trump administration dismantled the working group in March 2017 (Executive Order no. 13783, 2017) and then estimated a social cost of carbon of $1 to $6 per ton (U.S. Environmental Protection Agency, 2017b). The most important difference between the two calculations is that the Trump administration only considered climate impacts within the United States; the Obama administration considered global impacts. Additionally, the discount rates used in the Trump administration analysis were higher, meaning that future damages are given relatively less weight than current costs.

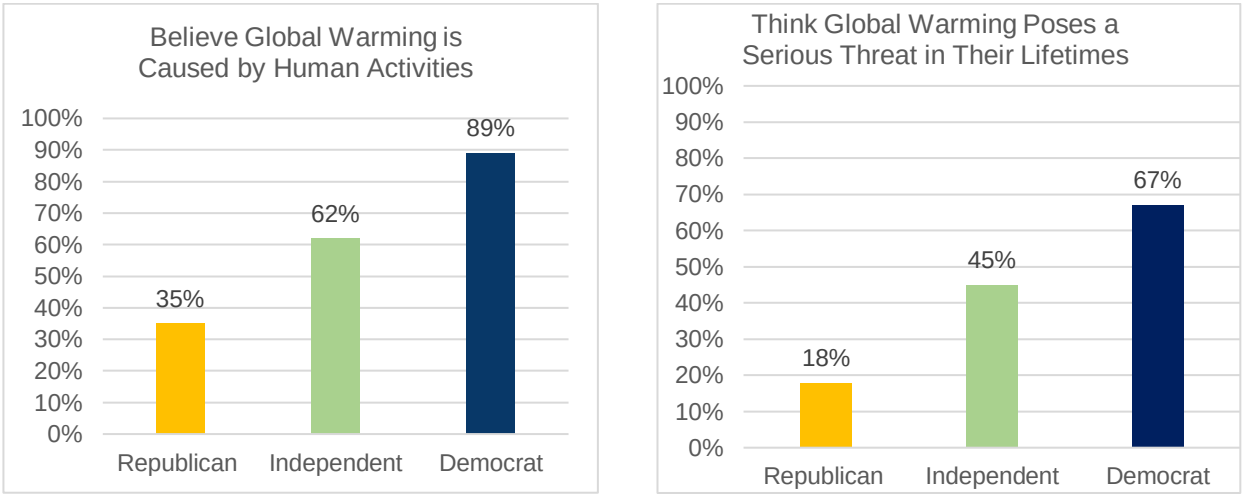
Another example of the Trump administration's push to undo environmental regulation is the EPA's push against "secret science", defined as science where the underlying data is not publicly released. Particularly

under fire are studies linking air pollution and other environmental exposures to health effects and premature death, because the underlying individual health data cannot be released for privacy reasons. A "secret science" rule could eliminate the scientific underpinning of regulation of pollution that harms human health. EPA recently delayed this rulemaking process until 2020 (Office of Information and Regulatory Affairs in the Office of Management and Budget, 2018) after receiving more than half a million comments in 3 months (U.S. Environmental Protection Agency, 2018e). Since the health co-benefits of reducing pollution are an important part of climate regulation, this change would undermine climate action as well.

U.S. PUBLIC OPINION

Despite President Trump's efforts, a majority of the public in the United States believes that the government should do something about climate change. A recent poll found that 61 percent of respondents said that the U.S. government should do "a great deal" about climate change, and a similar number said that the government is actually doing "little or nothing" (Resources for the Future, 2018). Another poll showed that in both the United States and Europe, 42 percent of people said that they are very concerned about climate change (Pew Research Center, 2016). Similar levels of public concern are certainly playing out differently in domestic policy and in international negotiations.

Figure 1: U.S. attitudes toward climate action



Source: Gallup Annual Survey on the Environment, March 2018

An important reason for the discrepancy between public attitudes and policy is that climate change concern in the United States is concentrated among Democratic and independent voters. As shown in Figure 1, 89 percent of Democrats and 62 percent of independent voters agree that global warming is caused by human activities (Jones & Saad, 2018). Only 35 percent of Republicans agree, and only 18 percent of Republicans believe that climate change will be a serious threat in their lifetimes (*ibid)*. Even those who are concerned about climate change may prioritize other issues, such as economic or social concerns, while voting. Combining this phenomenon with the Republican Party's stance against climate policy has resulted in U.S. policy that does not reflect the concerns of the population.

There is no end in sight to this challenge, as U.S. politics is becoming more polarized over time. The November 2018 Congressional elections demonstrate the ongoing challenge. The election was widely viewed as a referendum on President Trump, and Democrats gained control of the House of Representatives. However, many moderate Republicans in the House lost their seats, as moderate districts generally elected Democrats. Twenty-two Republican members of the House climate solutions caucus – half of its Republican members – retired or lost their seats in the election (Coren, 2018). As a result, there are now many fewer people on the Republican side of the aisle with an inclination to cooperate with Democrats on climate issues, making this Congress even more polarized than the last.

Key messages

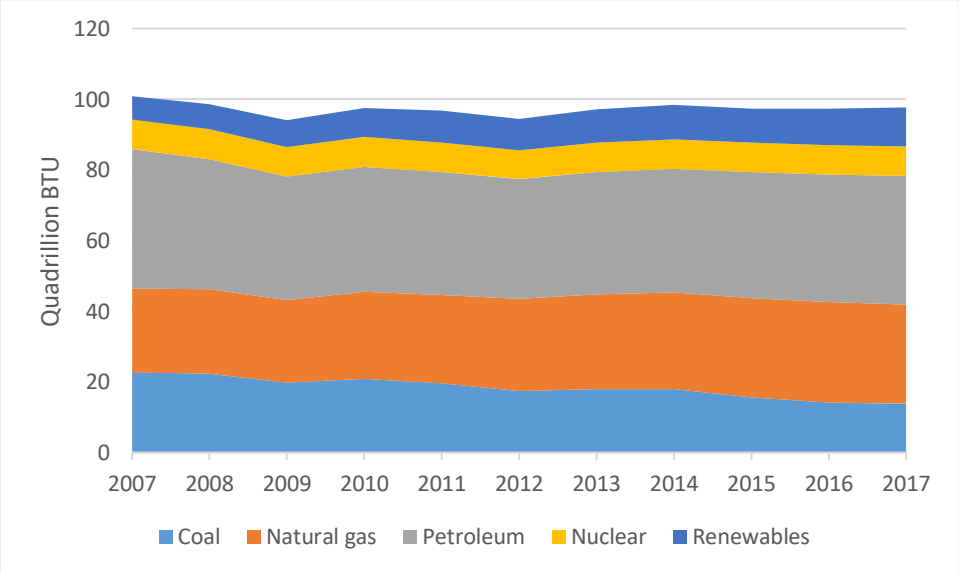
- In the U.S., the *policies* and *politics* of the low-carbon energy transition and climate change are inextricably linked.
- A majority of Americans believes that government should act on climate change. Yet political polarization is acute, with concern over climate change split between party lines.
- After the Democrats lost control of Congress in 2010, the Obama administration was forced to abandon full-fledged climate legislation and resort to regulation and executive orders to implement climate and environmental policies. However, measures of this type are less economically efficient and easier to undo.
- With the Republican party currently controlling both the presidency and the Senate, President Trump is systemically dismantling the climate and environmental policies of the Obama administration.
- In addition, by changing the calculation methods for the social cost of carbon and attempting to pass a "secret science" rule that would attack climate science – the very basis of climate policy, the Trump administration is directly altering the way climate is considered in regulatory decision-making.

2. ENERGY MIX, EMISSIONS AND POLICIES

Despite President Trump's policies, U.S. greenhouse gas emissions have generally been falling. The most recent official EPA emissions report showed 2017 emissions were 13 percent lower than in 2005, the base year for the U.S. Nationally Determined Contribution (NDC) under the Paris agreement (U.S. Environmental Protection Agency, 2019).

Energy use has been falling in the United States, even as the economy has grown. In the last decade, energy use fell 1.7 percent while GDP grew 15.3 percent over the period (The Business Council for Sustainable Energy, 2018, p. 2). The most important changes in primary energy consumption over the last decade have been a decline in coal, from 23 percent to 15 percent of U.S. primary energy consumption, accompanied by an increase in natural gas from 23 percent to 29 percent and in renewables from 6 percent to 11 percent.[1]

Figure 2: U.S. primary energy consumption, by source



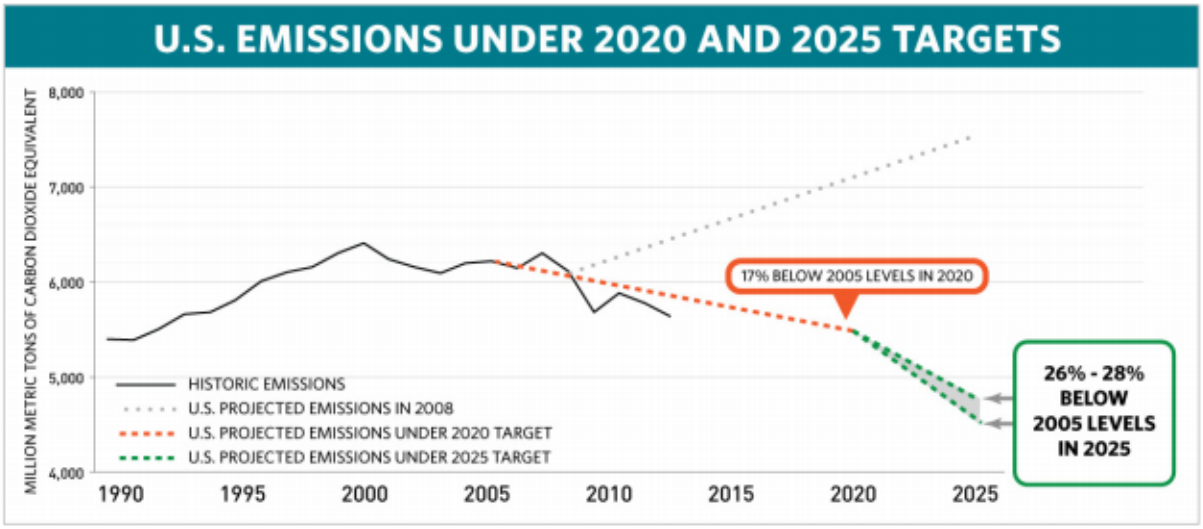
Source: U.S. Energy Information Administration (2018c)

However, data show that the emissions trend reversed in 2018, with energy-sector emissions rising 2.7 percent last year. A cold winter, robust growth in air and freight transport, and growing industrial activity drove the emissions increase (Houser *et al.*, 2019). Even in the power sector, 2018 emissions increased slightly, as power demand increased and gas-fired generation covered most of the new demand.

Additionally, the United States is not on track to meet the NDC set by the Obama administration, shown in Figure 3. The NDC promised reductions of 26 to 28 percent by 2025, building on the U.S. commitment at the 2009 UNFCCC Copenhagen conference to reduce emissions 17 percent by 2020.

[1] Calculated from data in U.S. Energy Information Administration (2018c).

Figure 3: United States emissions targets, Copenhagen and Paris NDC



Source: The U.S. Government's Nationally-Determined Contribution to the Paris Agreement

The power and transportation sectors are the largest contributors to U.S. greenhouse gas emissions, each contributing 28 percent of the total (U.S. Environmental Protection Agency, 2016). They are also the focus of policy to reduce energy use and emissions, and thus important sectors to examine in this analysis.

POWER SECTOR

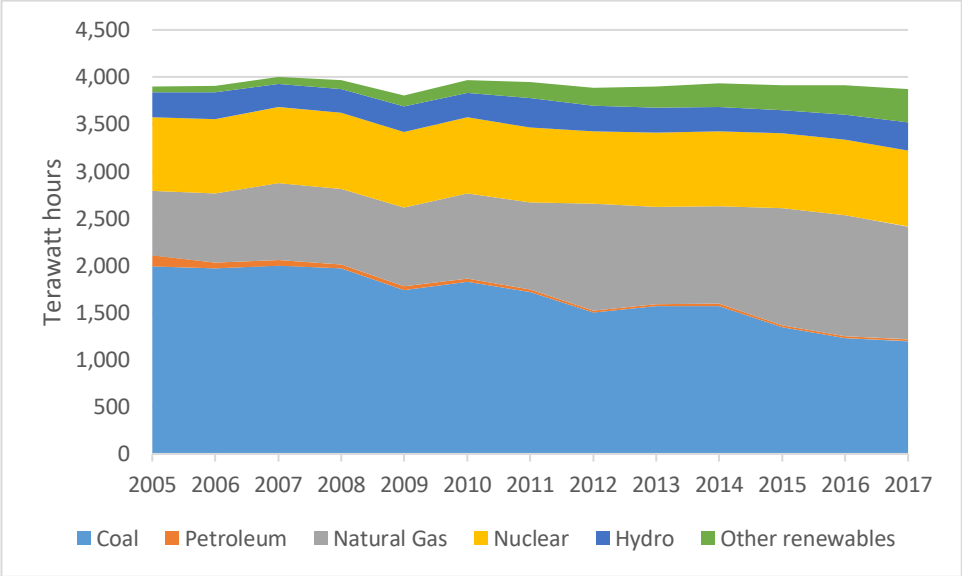
The emissions reductions that we have seen to date have been mostly in the power sector. Power demand has been flat over the past decade, but the United States has seen a 25 percent reduction in emissions from the electricity sector, primarily because of a shift away from coal in power generation (U.S. Environmental Protection Agency, 2018b, table 3.7). One often hears the narrative that President Obama waged a war on coal, but the real warrior was natural gas and the driver was economics rather than policy.

A revolution in natural gas production in the United States began around 2005, when the combination of horizontal drilling and hydraulic fracturing drastically increased natural gas production and reduced prices. U.S. natural gas production has grown more than 50 percent since 2005, and the price is now less than half the 2005 level in nominal terms.[2] The United States has become a net exporter of natural gas.

Inexpensive natural gas has been out-competing coal in the power sector. Additionally, many coal-fired power plants were older, inefficient, and less capable of flexing their generation to accommodate growing renewable power production. These factors combined to create a rush toward gas. As shown in Figure 4, coal consumption in the power sector has dropped 36 percent and gas consumption has grown 57 percent since 2005.[3] Capacity factors for coal plants have declined from nearly 70 percent in 2010 to approximately 55 percent today (U.S. Energy Information Administration, 2018b). Since 2010, nearly 40 percent of U.S. coal-fired generating capacity has been shut down or is scheduled to be shut down (Natter, 2018). Adding to the benefit from the shift toward gas, natural gas use has become more efficient and lower in emissions as combined cycle gas turbines have improved and become more widely used.

[2] Calculated from data in U.S. Energy Information Administration (2018c).
[3] ibid

Figure 4: U.S. electric power generation, by fuel source

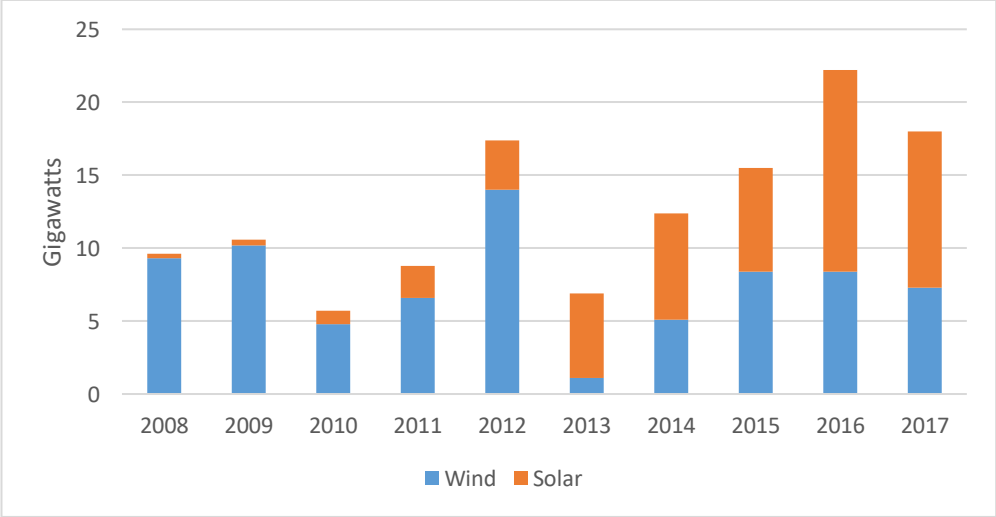


Source: U.S. Energy Information Administration (2018c)

Renewable electricity made up 17 percent of U.S. generation in 2017.[4] Nearly half of that total was hydropower, but wind and solar made up 7.6 percent of U.S. electricity generation.[5] The percentage of non-hydro renewables (including wind, solar, and geothermal) in total primary energy grew from 0.6 percent in 2007 to 3.4 percent in 2017, primarily due to rapidly declining costs for wind and solar.

Solar and wind projects have made up the majority of new power capacity built each year since 2014 and made up 62 percent of new power construction in 2017, although overall construction was down a bit due to policy uncertainty (Bloomberg New Energy Finance, 2019). Solar has taken over from wind as the largest source of new capacity, but recent data shows that President Trump's tariffs on Chinese solar panels are taking a bite out of 2018 utility-scale solar investment (Groom, 2018). Since U.S. power demand is flat, increasing renewable capacity is primarily taking the place of retiring coal plants.

Figure 5: Annual wind and solar capacity added in the United States



Source: Bloomberg New Energy Finance, Clean Energy Investment 2018

[4] Calculated from data in U.S. Energy Information Administration (2018c).
[5] ibid

Several federal policies support wind and solar development in the United States, particularly the Production Tax Credit for wind, which will phase out at the end of 2019. However, the states enact and implement the most important policies that encourage development of renewable power. These policies include renewable portfolio standards, which require utilities to purchase a specified amount of renewable power; net metering, which enables residential or commercial customers with solar generation to sell excess power back to the grid at a specified price; feed-in tariffs, which obligate utilities to pay specified above-market rates for renewable power; and various financial, financing, or tax incentives (U.S. Environmental Protection Agency, n.d.-e).

The Obama administration introduced the federal Clean Power Plan in 2015 to continue the trend of declining emissions from the U.S. power sector and as an important part of the plan to achieve the emissions reduction goal of the U.S. NDC. The Clean Power Plan was developed under the authority of the existing Clean Air Act and was intended to reduce power sector carbon dioxide emissions 32 percent by 2030 (U.S. Environmental Protection Agency, 2017a). It treated the power system as an integrated whole, and thus allowed a variety of strategies to reduce emissions, including increasing the end-use efficiency of electricity use and substituting low- or zero-carbon sources of generation. The Clean Power Plan also would have had the effect of eliminating coal-fired generation without carbon capture.

The Clean Power Plan faced challenges in court, particularly from states governed by Republicans. Legal scholars disagree about whether the flexible, "outside the fence line" approach is allowed under the Clean Air Act. In October 2017, the EPA Administrator announced that EPA would repeal the Clean Power Plan. Nonetheless, a 2009 U.S. Supreme Court ruling stated that CO_2 is a pollutant that must be regulated under the Clean Air Act, meaning that the Trump administration is required to develop a replacement.

In August 2018, the Trump administration proposed the Affordable Clean Energy Rule, which provides no target for CO_2 emissions reductions. The EPA's own analysis shows the rule results in only a 1 percent reduction in CO_2 emissions compared to no regulation at all. [6] Unlike the previous policy, the Affordable Clean Energy Rule considers each power plant individually, rather than taking a system-wide approach to reducing CO_2 emissions from the power sector. The applicable "best policy" is improving the heat rate, or efficiency, of existing power plants. The rule does not consider emissions reductions that could be achieved in the overall power system by fuel switching, increasing renewable power generation, or increasing the efficiency of power use, thus reducing demand (U.S. Environmental Protection Agency, 2018a). This is clearly not an approach designed to reduce emissions from the power sector as a whole in a cost-effective manner.

Even worse, the Affordable Clean Energy Rule is not designed to discourage coal-fired power generation. Efficiency improvements at existing coal plants will not help the U.S. achieve its NDC, let alone achieve the deep decarbonization required to prevent the worst effects of climate change. In addition to not reducing CO_2 emissions, the rule is likely to increase emissions of local pollutants like sulfur oxides, nitrogen oxides, and fine particulates. The EPA estimates that moving from the Clean Power Plan to the Affordable Clean Energy Rule would result in nearly 1,000 annual premature deaths in 2030, mostly due to very fine particulate matter, known as PM2.5 (U.S. Environmental Protection Agency, 2018d, table 4.6).

Nuclear power is another important source of zero-carbon electricity. The United States has 99 nuclear reactors that together produce 20 percent of U.S. electricity (U.S. Department of Energy Office Of Nuclear Energy, 2018). However, similar to coal-fired power, nuclear generation is currently struggling because of inexpensive natural gas. The Trump administration has lumped coal and nuclear power together in an attempt to save both, noting the security advantage of their storage of significant fuel onsite and the ongoing need for baseload power. This is a tricky argument—outages tend to be caused by problems in transmission and distribution, not in generation. Natural gas can certainly provide baseload power. And lumping together the power generation fuel with the highest carbon emissions with a significant source of

[6] See U.S. Environmental Protection Agency (n.d.-a). U.S. power sector emissions in 2017 were approximately 1.7 billion metric tons.

low-carbon electricity clearly misses an important advantage of nuclear power. Nonetheless, the federal government does not recognize the low-carbon advantages of nuclear power, although a few states have done this in an effort to save their nuclear plants. Even the Obama-era Clean Power Plan did not recognize the carbon-free nature of existing nuclear power, although it did give credit for upgrades to existing plants. If the trend of shutting down non-competitive nuclear plants continues, the United States will be challenged to continue the downward trend of power sector CO_2 emissions.

Key messages:

- The power sector has largely been responsible for the decline in GHG emissions in the U.S. over the past decade: power demand has been flat, but emissions have dropped by 25 percent.
- This decrease was not driven by a policy 'war on coal', but rather by the economics of natural gas. The revolution in U.S. natural gas production cut gas prices in half, putting pressure on both coal and nuclear generation, and leading to the scheduled or actual shutdown of 40 percent of U.S. coal-fired capacity since 2010.
- Nuclear reactors, meanwhile, currently produce 20 percent of U.S. electricity, but this source of zero-carbon electricity is likewise under threat due to the competitiveness of natural gas.
- In 2017, renewable electricity made up 17 percent of U.S. generation, split almost equally between hydropower and wind/solar. Solar and wind projects have accounted for the majority of new power capacity built since 2014, due to their rapidly declining costs, along with federal and mainly state policy support. The U.S. tariffs on Chinese solar panels and current policy uncertainty, however, have subdued that growth somewhat.
- In terms of policy, the Obama administration introduced the federal Clean Power Plan in 2015, which was intended to reduce power sector CO_2 emissions by 32 percent by 2030.
- This plan has been met with fierce legal challenges, and the Trump administration has proposed to replace it with the Affordable Clean Energy Rule, which contains no target for CO_2 reductions and which would result in only a 1 percent reduction in emissions versus no regulation at all.

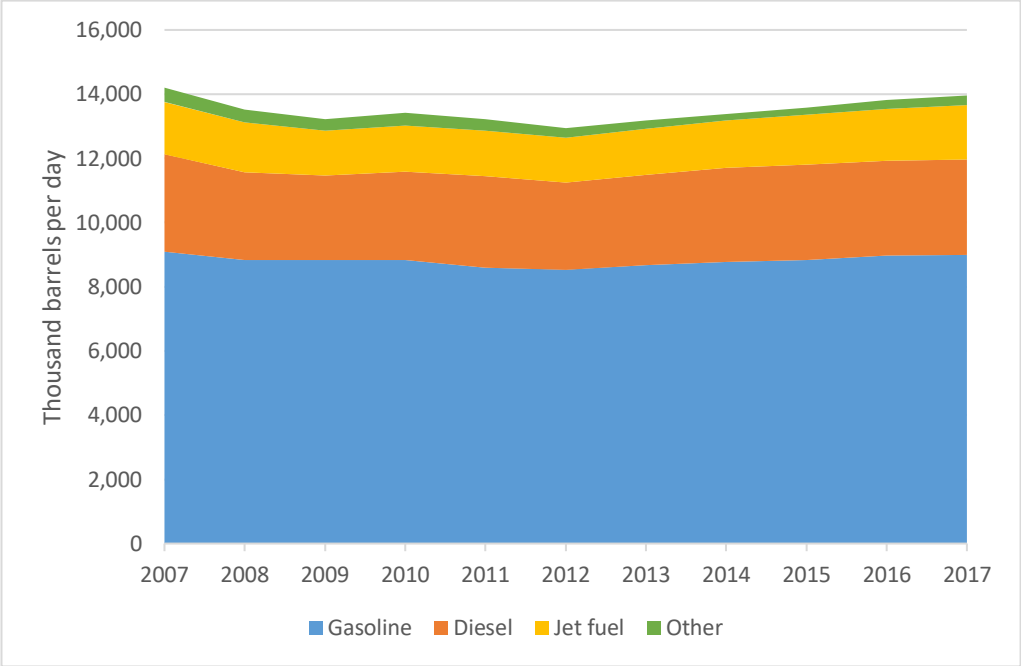
TRANSPORTATION SECTOR

The emissions story in the U.S. transportation sector is less rosy than in the power sector. Transport sector emissions are on a long-term upward trend and have increased every year since 2012 (U.S. Environmental Protection Agency, n.d.-d).

The light vehicle fleet is the easiest place to start a transition toward greater efficiency and lower carbon fuels. Light vehicles are responsible for 60 percent of greenhouse gas emissions from the U.S. transportation sector (U.S. Environmental Protection Agency, n.d.-b). Additionally, heavy freight, shipping, and aviation are all more difficult to transition, since the energy density of petroleum fuels are particularly important in these sectors. For these reasons, efforts to reduce emissions from transport focus on the light vehicle fleet.

The U.S. light vehicle fleet is quite different from that in Europe. Light vehicles in the United States are overwhelmingly powered by gasoline. Motor gasoline is around 65 percent of U.S. transport fuel and this has been broadly consistent for decades (U.S. Energy Information Administration, 2018c).

Figure 6: U.S. transportation fuel use



Source: U.S. Energy Information Administration (2018c)

Additionally, U.S. car culture is very real. In the United States, there are approximately 1.2 registered vehicles per licensed driver (Statista, n.d.). Seventeen million light-duty vehicles were sold in the US in 2017 (Stoddard, 2018), compared to 15.2 million in the European Union (International Council on Clean Transportation, 2018). Cars in the United States are larger on average than those in Europe. The average mass of a light-duty vehicle in the European Union is just under 1,400 kilograms (kg) with a 127 horsepower engine (*ibid)*. In the United States, those numbers are 1,830 kg and 230 horsepower (U.S. Environmental Protection Agency, n.d.-c). This is a huge difference in power. However, cars made up only 47 percent of U.S. light-duty vehicle sales in 2017 – sport utility vehicles (SUVs) and trucks together comprised the other half of light-duty sales, and these are larger with larger engines (U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, 2017, tables 4.8, table 4.10 and table 4.12).

Sales of plug-in electric vehicles are increasing rapidly, making up 2 percent of light vehicle sales in 2018, up from 1.2 percent in 2017.[7] More and more models are available all the time (43 models of plug-in vehicles were available in the United States at the end of 2018 (Loveday, 2019) and important manufacturers are betting their future on the success of electric vehicles. Nonetheless, changing America's love for large, powerful vehicles will be a challenge.

The Trump administration's policy is not encouraging that change. The Trump administration has initiated a rollback of U.S. light vehicle fuel economy standards that will have a significant effect on U.S. CO_2 emissions and energy use. U.S. fuel economy standards were last updated in 2012, and before President Obama left office, his administration finished a planned midterm review of these standards. However, the Trump administration re-opened and re-did this review, with very different analysis and assumptions.

In October 2018, the Trump administration proposed to freeze fuel economy standards at the model year 2020 level through model year 2026 (U.S. Environmental Protection Agency, 2018f). They also proposed to remove California's right to set its own stricter emissions standards (and other states' right to adopt those standards instead of the federal ones), a right established in the 1960s. The 2012 standards were

[7] Calculated from data in Marklines (2019) & Loveday (2019).

established in a deal between California and the federal government to keep consistent standards across the United States.

Even the Alliance of Automobile Manufacturers was opposed to this freeze in fuel economy standards – stating that it supported year-on-year improvements in fuel economy (Auto Alliance, 2018). Automobile manufacturers also desperately want to avoid having more than one standard in the United States: California will sue to maintain its right to set its own standards, and the resulting litigation could bring significant uncertainty for automakers.

In terms of fuel use and the resulting greenhouse gas (GHG) emissions, this rollback of standards could be even worse than the replacement of the Clean Power Plan, potentially adding nearly 1 billion tons of CO_2 to the atmosphere between now and 2035 (Houser *et al.*, 2018). Why is this so bad? Because the market is not providing a tailwind for reducing emissions like it is in the power sector, where inexpensive natural gas, falling renewable prices, and flat demand are generally pushing emissions down even without policy intervention.

Continuing a theme, the justification behind the change in fuel economy standards is tortured. The administration claims that the rollback of standards will save 1,000 lives per year by making new cars cheaper, thus getting people into newer, safer cars. They also claim that if cars were more efficient, people would drive them more and thus there would be more fatalities (U.S. Environmental Protection Agency, 2018c; U.S. Department of Transportation, 2018).

Another scary fact is buried in the fine print of the justification for the new fuel economy rules: the analysis says that it expects the atmospheric CO_2 concentration to reach 790 parts per million (ppm) by the end of the century. That level is then used to point out that rolling back U.S. fuel economy standards would make a negligible difference in the CO_2 level (U.S. Department of Transportation, 2018). To the extent that the administration considers the impact of U.S. cuts in CO_2 emissions, it slices them into small pieces by sector and regulation, and then claims that none of them is big enough to make a difference in the overall outcome. By this logic, no single program or policy to reduce emissions is likely justifiable – only the combination of many policies in many countries and sectors will be enough to meaningfully change the global emissions path.

Key messages:

- As opposed to the power sector, U.S. transport emissions are on a long upward trend: they have increased every year since 2012.
- The light vehicle fleet, which accounts for 60 percent of the country's transport emissions, is the easiest place to start a transition.
- However, the U.S.'s deeply embedded car culture forms a real social hurdle to further action. There are approximately 1.2 registered vehicles per licensed driver, and cars in the U.S. are on average larger than those in Europe.
- In addition, the transport sector lacks the tailwinds for emissions reductions that the market provides in the power sector (inexpensive natural gas, falling renewable prices, and flat power demand).
- The Trump administration has engaged in a rollback of fuel economy standards, which has been hotly contested. The effect could be even worse than the replacement of the Clean Power Plan, leading to nearly 1 billion tons of additional CO_2 emissions per year to 2035.
- The justification for the change in fuel economy standards is tortured, and demonstrates an overall trend in the Trump administration's climate policies: by considering each individual action too small to make a difference to the overall outcome, no single program or policy to reduce emissions is likely justifiable.

3. FUTURE SCENARIOS

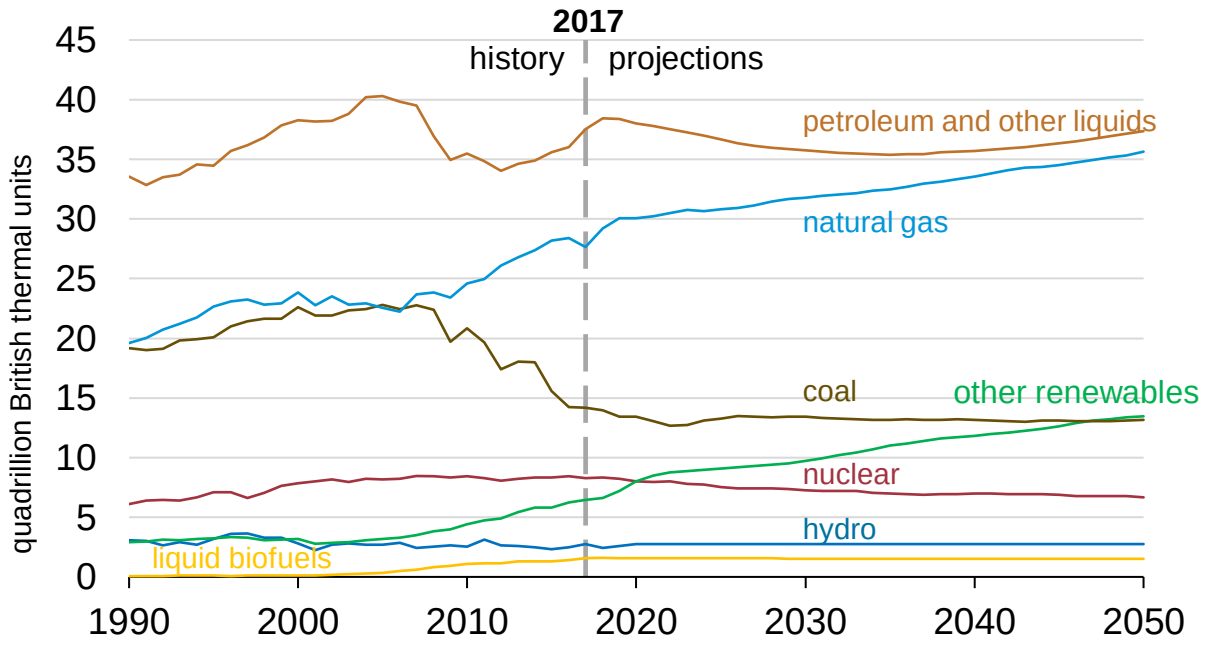
To explore future paths for the U.S. energy mix and greenhouse gas emissions, I consider three different analyses: the U.S. Energy Information Administration's (EIA) Annual Energy Outlook, the Taking Stock 2018 report from the Rhodium Group, and the Fulfilling America's Pledge report from Bloomberg Philanthropies, prepared by a group of universities and think tanks.

The Annual Energy Outlook and the Rhodium Group analysis are similar; they both focus on the energy mix and resulting emissions from current U.S. federal policy, using the same underlying model and similar assumptions. These analyses do not paint a pretty picture of the U.S. emissions future.

As shown in Figure 6, the EIA projects that renewables will grow rapidly. However, in 2030, they still make up only 23 percent of U.S. electricity generation, and in 2050, 27 percent (11 percent and 14 percent of total primary energy). Natural gas consumption also grows rapidly, to 32 percent of U.S. primary energy in 2030 and 33 percent in 2050 (U.S. Energy Information Administration, 2018a). This could be a good outcome if gas in power generation was paired with carbon capture and storage, but current policy contains very limited drivers to make that happen.

The EIA projects that demand for petroleum and coal will be flat to even growing slightly after 2030 under current U.S. policies. This outcome is clearly not consistent with the kind of deep decarbonization needed by mid-century to achieve the world's overall climate goals.

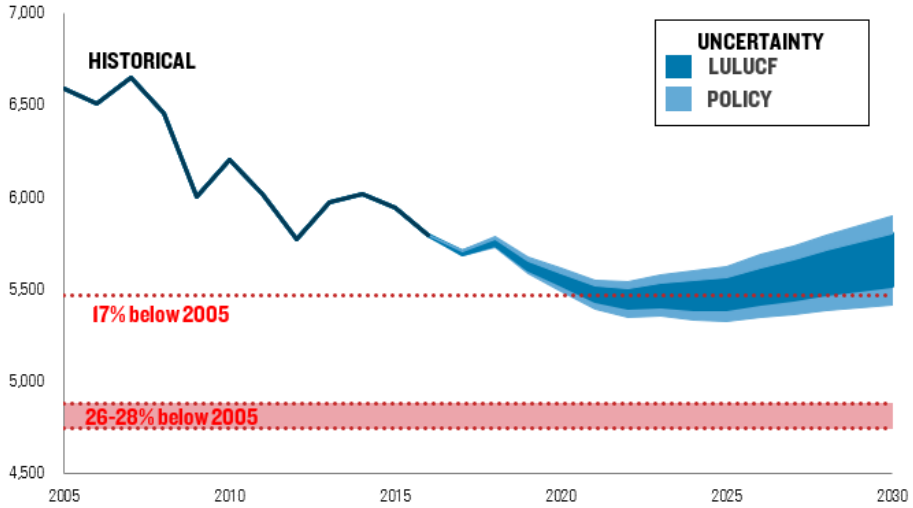
Figure 7: U.S. energy consumption by fuel, historical and projected



Source: U.S. Energy Information Administration, 2018a

The Rhodium Group's greenhouse gas emissions analysis estimates that 2025 U.S. emissions will be 12 to 20 percent below 2005 levels in 2025, compared to the US NDC of 26 to 28 percent (Figure 7). However, if the United States maintains current policies, emissions would begin to rise after 2025 (Larsen *et al.*, 2018).

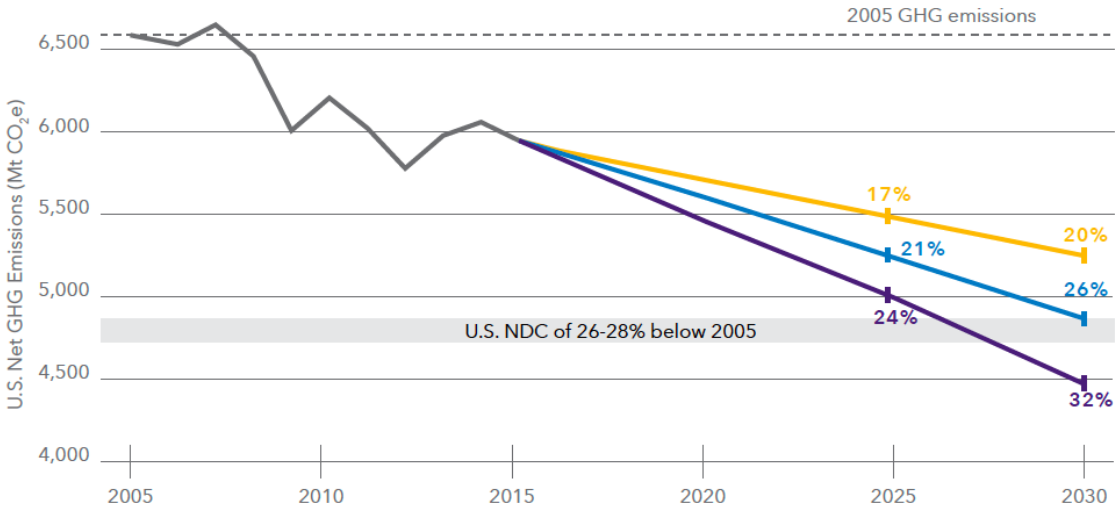
Figure 8: Net U.S. greenhouse gas emissions under current policy



Source: Rhodium Group

Nevertheless, we must remember that current policy is not destiny. The Trump administration will not be in power forever, and the administration's rollback of federal climate and environmental programs has inspired a great deal of effort among state and local governments, businesses, and civil society in the United States. Two hundred eighty cities and counties, ten states, and more than 2,000 businesses are part of the "We are Still In" coalition that pledges to continue efforts to reduce emissions in line with the goals of the Paris Agreement. All together, the coalition represents more than half of the U.S. population and $9.5 trillion in GDP.[8]

Figure 9: Fulfilling America's Pledge emissions scenarios



Source: Fulfilling America's Pledge, www.americaspledge.com

The Fulfilling America's Pledge study considered ten high-impact and readily available opportunities that cities and states could undertake to reduce GHG emission and an additional set of more ambitious actions (Bloomberg Philanthropies, 2018). Each of these actions could be undertaken at the state level and does not require changes in federal policy. The ten "climate action strategies" would bring U.S. emissions to 21

[8] See, We are Still In coalition, at https://www.wearestillin.com/.

percent below 2005 levels in 2025. Adding more ambitious actions would bring U.S. emissions down to 24 percent of their 2005 level – very close to the 26 percent to 28 percent in the NDC.

This effort is focused on achieving the U.S. NDC rather than spurring a transition to low carbon energy, but clearly the two goals are linked. By far, the largest reductions in greenhouse gas emissions are in the power sector, hastening the trend of shutting down coal plants and increasing the pace of investment in renewable power generation. Smaller gains came from increasing building efficiency and providing incentives for the purchase of electric vehicles.

Clearly, re-engagement from the U.S. federal government could result in even larger gains. In particular, vehicle efficiency is in federal hands. Bringing back steady improvement in light vehicle efficiency standards and continuing improvement in other categories of vehicles would be fruitful in America's largest emissions sector.

Key messages:

- Under current projections, the U.S. is not on the right track to achieve the deep decarbonization needed to mitigate climate change.
- The U.S. Energy Information Administration projects that under current policies, demand for petroleum and coal will remain flat or even grow slightly by 2030. Natural gas consumption will grow rapidly, but in the absence of carbon capture and storage, the ensuing emissions reductions will not suffice. Renewables, meanwhile, will grow rapidly, but they will only rise to 23 percent of U.S. power generation by 2030 and 27 percent by 2050.
- U.S. emissions will be 12 to 20 percent lower than 2005 levels by 2025, according to Rhodium Group estimates. This is nowhere near the US NDC of 26 to 28 percent reductions.
- In spite of federal policy, large coalitions of state and local governments, businesses and civil society organizations have formed in order to continue efforts towards meeting the Paris targets. A study has shown that if states implement ten high-impact and readily available opportunities, U.S. emissions could be brought down to 21 percent below 2005 levels by 2025.
- Clearly however, re-engagement from subsequent federal administrations could result in even larger gains.

4. CONCLUSION

The huge increase in domestic oil and natural gas production that the United States has experienced over the last decade has changed the political calculus of renewable energy and energy efficiency. Past efforts for energy efficiency and a transition away from fossil fuels were often rooted in concerns about energy security as much as concerns about the environment or climate. With energy security less of a concern given the U.S. resource base, an important political argument for a low-carbon energy transition is greatly diminished.

Additionally, the U.S.'s emergence as the world's largest petroleum producer has implications for the global transition toward lower-carbon energy sources. These implications aren't all negative. Increasing exports of natural gas could be helpful if they replace higher-carbon fuels like coal, and U.S. producers and regulators are focused on minimizing emissions of methane, the primary component of natural gas and a potent greenhouse gas. Nevertheless, the current U.S. administration is citing the new abundance of oil and gas in the United States as a reason not to encourage a global transition away from fossil fuels, and officials have touted the benefits of fossil fuels in international forums.

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