PROJECTING AND ACCELERATING U.S. GREENHOUSE GAS REDUCTIONS

CENTER FOR CLIMATE AND ENERGY SOLUTIONS

Doug Vine, Center for Climate and Energy Solutions

More than 190 nations representing more than 95 percent of global greenhouse gas emissions offered "nationally determined contributions" (NDCs) to the Paris Agreement reached in December 2015. The NDC submitted by the Obama administration on behalf of the United States is an economy-wide target to reduce net greenhouse gas emissions 26 to 28 percent below 2005 levels by 2025. The Trump administration is now weighing whether to "suspend, revise, or rescind" policies to help meet this goal, and has announced its intent to withdraw from the Paris Agreement. President Trump has also suggested the possibility of "reentry" under revised terms; one option may be a recalibrated U.S. NDC. Analyses suggest that even with some key climate policies rolled back, U.S. emissions in 2025 could range from 14 percent to 18 percent below 2005 levels. In the absence of additional federal policy, stronger action by states, cities and companies can help reduce emissions further. The brief looks at progress in reducing U.S. emissions, how existing and proposed policies may affect emissions through 2025, and additional steps that can achieve stronger reductions.

WHAT'S HAPPENED SINCE 2005

As noted, the United States' NDC is set relative to a "base year" of 2005. As of the end of 2015, the latest year for which complete data are available, U.S. net emissions were 11.5 percent below 2005 levels (see Figure 1).[1,2] A range of factors, both market- and policy-related, contributed to this decline. Electric power sector emissions fell 21 percent as a result of a shift from coal to natural gas, increased use of renewable energy, and a leveling of electricity demand.[3] Improved vehicle efficiency helped reduce transportation-related emissions by nearly 10 percent (though transportation emissions have been increasing since 2012). Industrial emissions fell 4 percent, the result of fuel switching, greater energy efficiency, and the continued shift to a more service-oriented economy.[4,5]

EMISSIONS OUTLOOK FOR 2025

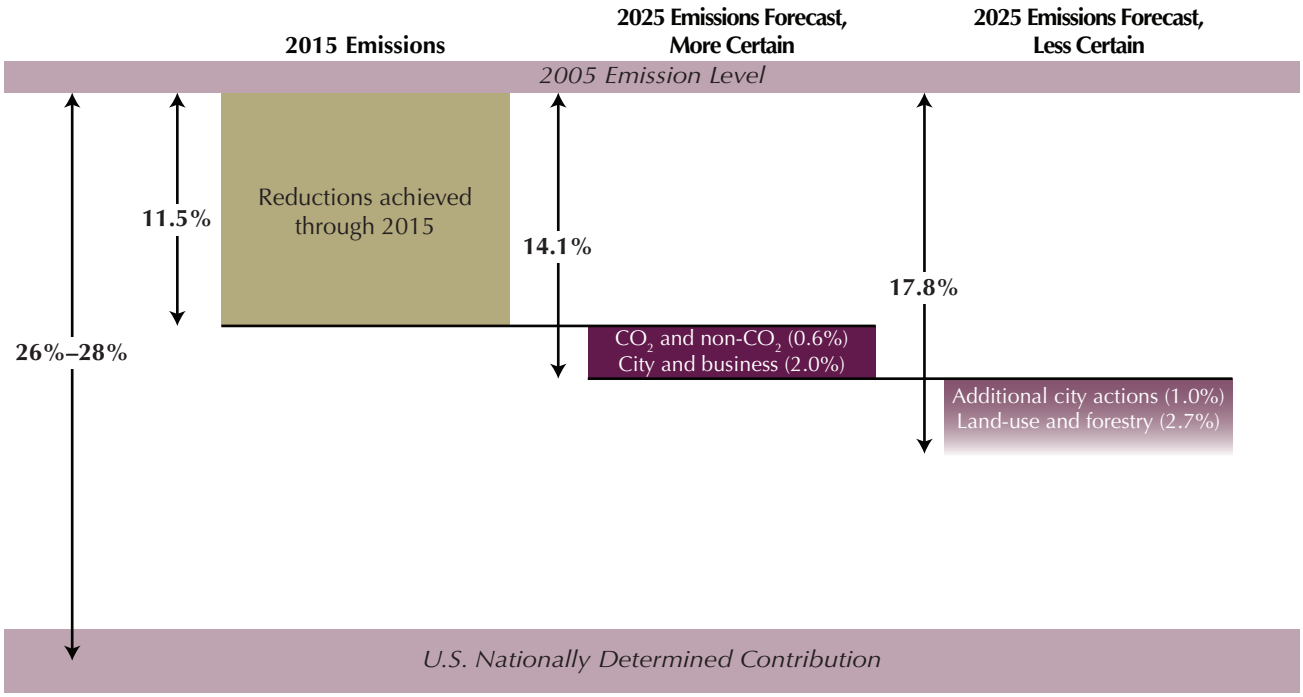
Drawing together a number of analyses, our emissions outlook for 2025 projects reductions of 14 percent to 18 percent below 2005 levels, depending on whether the U.S. land use sector continues to serve as a major carbon sink (it currently offsets almost 12 percent of U.S. emissions).

Table 1 summarizes the key components of this emissions outlook.

ENERGY-RELATED CO_2 EMISSIONS

The Energy Information Administration (EIA) projects that energy-related carbon dioxide emissions will remain essentially flat under a business-as-usual scenario, increasing just 0.1 percent from 2015 levels by 2025.[6] In the power sector, the scenario incudes the December 2015 extension of federal tax credits for wind and solar power, but excludes the Environmental Protection Agency's (EPA) Clean Power Plan, which the new administration intends to reverse or revise; it projects emissions declining by 63 $MMtCO_2e$, or 3 percent, from 2015 levels by 2025.[7] This scenario also assumes that nuclear plant closures do not accelerate.[8] In the transportation sector, greenhouse gas standards for vehicles are expected to reduce emissions 4 percent or by 80 $MMtCO_2e$ after 2019.[9]

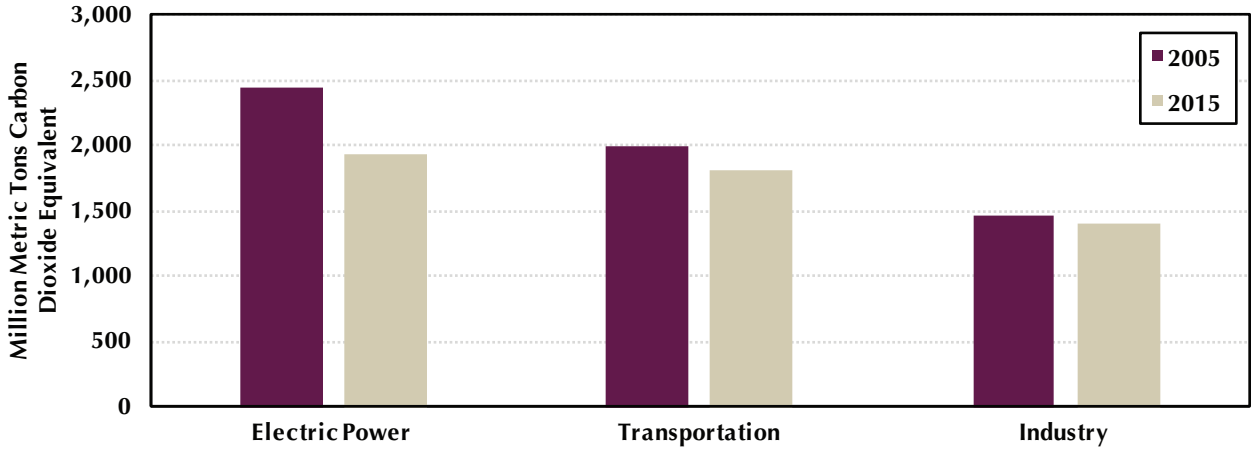
FIGURE 1: Outlook for 2025 Emissions (Relative to 2015 Levels)



The U.S. goal set by the Obama administration under the Paris Agreement calls for a net reduction of greenhouse gas emissions of 26 to 28 percent below 2005 levels by 2025. The top line in this figure represents net U.S. emissions in 2005. The boxes represent emission reductions achieved through 2015, and reductions forecast from 2015 to 2025 for: CO_2 and non-CO_2 emissions; additional city and business actions; and land use, land-use change and forestry (LULUCF) sector. In total, these would reduce emissions 14–18 percent from 2005 levels by 2025.

Sources: EPA, EIA, State Department (2017), NREL (2016)

FIGURE 2: Change in Emissions by Sector, 2005 to 2015



Source: EPA (2017)

TABLE 1: Components of the 2025 Emissions Outlook

EMISSION CATEGORIES	EFFECT IN 2025	% CHANGE FROM 2005 LEVEL*
Reductions achieved through 2015	-755 $MMtCO_2e$	-11.5%
Additional reductions by 2025:		
Total CO_2** and Non-CO_2	-39 $MMtCO_2e$	-0.6%
City and business action	-130 $MMtCO_2e$	-2.0%
Additional city action	0 to -70 $MMtCO_2e$	0 to -1.0%
Land use and forestry (carbon sink)	0 to -181 $MMtCO_2e$	0 to -2.7%
Net	-923 to -1,174 $MMtCO_2e$	14.1 to 17.8%

Note that net emissions are equal to total greenhouse gas emissions (carbon dioxide, methane, and nitrous oxide, and fluorinated gases) minus withdrawals to carbon sinks. MMtCO2e is million metric tons of carbon dioxide equivalent.

* Based on 2005 base year net emissions as reported in the Inventory of U.S. Greenhouse Gas Emissions and Sinks, 1990 - 2015 (EPA, 2017)

** Excludes the EPA's Clean Power Plan and includes Congressional tax credits for wind and solar. Includes forecast for all economic sectors. Includes enacted state actions, including recently increased GHG reduction targets from California and New York.

Sources: EPA (2017), EIA (2017), State Department (2015).

However, industrial emissions are expected to grow by more than 180 $MMtCO_2e$—fueled by low prices for energy, particularly natural gas and natural gas liquids.[10]

NON-CO_2 EMISSIONS

EPA projected in 2016 that emissions of non-CO_2 greenhouse gases—methane, nitrous oxide, and fluorinated gases (hydrofluorocarbons (HFCs), perfluorocarbons and sulfur hexafluoride)—would increase 97 $MMtCO_2e$ from 2015 levels by 2025.[11] However, new federal rules on methane and HFCs under the recent Kigali amendment to the Montreal Protocol, are now projected to achieve a net reduction in non-CO_2 emissions of 40 $MMtCO_2e$.[12,13]

The new methane rules include: new source performance standards (NSPS) for new oil and gas production facilities; standards to reduce venting and flaring from oil and gas production on public lands and updated standards of performance for municipal solid waste landfills.[14,15,16] These rules are under review but face a lower risk of reversal. Finally, under the Kigali amendment, the United States will begin reducing the production and consumption of HFCs in 2019.[17,18,19]

Together, a slight rise in total CO_2 emissions (+1 $MMtCO_2e$) and a decrease in non-CO_2 emissions (-40 $MMtCO_2e$) result in a net decrease of 39 $MMtCO_2e$ in 2025, to 12.1 percent below 2005 levels.[20]

CITY AND BUSINESS ACTION

The computer models used to forecast future CO_2 and non-CO_2 emissions reflect major policies and broad energy and technology trends. However, they are not refined enough to fully capture the emissions impact of actions taken at the municipal and corporate levels. Separate analyses suggest that ongoing efforts by cities and businesses will reduce emissions an additional 130 $MMtCO_2e$ 2025 beyond the "business-as-usual" reductions in CO_2 and non-CO_2 cited above—or another 2 percent below 2005 levels.

With 86 percent of Americans living in metropolitan regions that generate more than 90 percent of the country's GDP, growing efforts by municipalities are beginning to deliver meaningful emission reductions.[21] These include efforts to improve energy efficiency, purchase renewable energy, expand infrastructure for electric vehicles, and increase use of public transit (Table 2). A recent study by the National Renewable Energy Laboratory (NREL) found that if all U.S. cities made reasonable progress implementing a set of key policies, U.S. emissions could be cut by 210 to 480 $MMtCO_2e$ per year by 2035.[22]

TABLE 2: Key City Policies

POLICY AREA	EXAMPLES
Benchmarking building energy consumption with an aim to achieving greater efficiency: In the United States, residential and commercial buildings account for 41 percent of total energy consumption, and 40 percent of carbon dioxide emissions.[23]	In 2011, the city of Philadelphia began benchmarking its buildings. Through energy reporting and other data collection, the city has already identified buildings with room for improvement in a sector responsible for 60 percent of the city's total emissions.[24]
Expanding financing opportunities: Helping cities and their residents and businesses retrofit to more energy-efficient appliances and equipment can reduce energy intensity.	Commercial and residential Property Assessed Clean Energy (PACE) programs provide a mechanism to finance a range of energy efficiency and renewable energy projects across a wide swath of U.S. municipalities.[25]
Improving passenger transport: Compact urban development, expanding public transportation opportunities, and/or improving vehicle efficiency can further reduce emissions.[26]	By expanding use of light rail and other forms of public transport, cities like Miami hope to reduce the number of private vehicles on congested roads.[27] Additionally, cities facilitating technological improvements for electric vehicle infrastructure, e.g. charging stations, would advance the adoption rate of electric vehicles, which would help EPA to set stricter standards in the post-2018 time period.
Increasing renewable energy consumption	Dozens of cities, including Chicago, Atlanta, and Salt Lake City, are committing to expand their use of renewable energy for municipal operations and community needs.

Steps taken by businesses beyond regulatory requirements are also delivering additional emission reductions. More than 150 U.S. companies with a combined market capitalization in excess of $7 trillion joined the American Business Act on Climate Pledge, with many offering commitments to reduce their greenhouse gas emissions through steps such as building or purchasing renewable power, improving their energy efficiency, or financing such efforts by others.[28] Ten of the 15 largest U.S. companies have pledged to procure 100 percent of their electricity from renewable sources (most before 2025) as part of the RE100 initiative.[29]

One challenge in accounting for municipal and corporate efforts not fully captured by the models is determining the degree to which the resulting emission reductions are actually additional to those driven by broader policy, energy and technology trends. A recent draft study by New Climate Institute, which took "additionality" into account, found that pledges by 54 cities (including the 20 largest in the U.S.) and 252 businesses would reduce annual emissions by around 130 MMtCO_2e in 2025 (or an additional 2 percent below 2005 levels).[30] (This is likely a conservative estimate, as the study excluded many other cities and companies that did not meet a rigorous set of criteria.) Given the NREL estimates cited above, growing efforts by cities could reasonably be expected to reduce emissions a further 70 MMtCO_2e by 2025 (or an addition 1 percent below 2005 levels). Greater reductions may be realized as efforts such as the We Are Still In coalition work to strengthen action by non-state actors. The America's Pledge initiative is undertaking a more systematic quantification of efforts by states, cities and businesses.[31]

LAND USE AND FORESTRY

Carbon sinks like forests, soils, grasslands, and bodies of water absorb carbon dioxide from the atmosphere, thereby offsetting some portion of total greenhouse gas emissions.[32] In its latest *Greenhouse Gas Inventory*, the United States reported that in 2015 the U.S. carbon sink offset almost 12 percent of gross U.S. emissions; 88 percent of the carbon sequestration was from forests.[33]

There is significant uncertainty about how much car-

bon dioxide the land use, land-use change, and forestry (LULUCF) sector will be able to sequester. Demand for forest products, aging forests, changes in land use, and climate change itself are altering the characteristics and dynamics of the sector.[34] Modeling by EPA, the U.S. Department of Agriculture (USDA) and the National Oceanographic and Atmospheric Administration (NOAA) provide a range of carbon sequestration projections. At the high end, the EPA's Global Timber Model projects that forests remain a large and increasing sink.[35] At the lower end, a USDA scenario assuming high population growth, leading to increased housing starts and forest conversion, projects greatly reduced sequestration.[36] The high-end carbon sink scenario would increase the U.S. sink by 181 $MMtCO_2e$ in 2025, while the USDA scenario would result in a small decrease.

Coupled with the changes forecast in CO_2 and non-CO_2 emissions, and city and business action, the EPA's projection for land use sequestration suggests emissions in 2025 of nearly 18 percent below 2005 levels.

OTHER POTENTIAL REDUCTIONS

In addition to the projections above of CO_2 and non-CO_2 emissons, city and business actions, and land use sequestration, other efforts already underway may produce greater emission reductions by 2025. For instance, increased clean and renewable energy production (spurred by market forces and tax credit extensions for wind and solar) could cut costs further, leading to higher deployment and lower emissions than projected by EIA. Notably, EIA forecast in 2005 that energy-related carbon dioxide emissions would increase 16 percent by 2014, when in fact they decreased nearly 10 percent.[37]

Further steps to achieve stronger emission reductions could include federal policies beyond those already initiated or in place, technological advances that lower the cost of emissions reduction, and stronger efforts by states:

Federal Action – Comprehensive carbon-pricing legislation would be the most cost-effective means of driving further emission reductions. Congressional action on tax reform or infrastructure could provide an opportunity to consider comprehensive pricing. Short of legislation, federal agencies could take further action under existing statutes; for instance, EPA could set greenhouse gas standards for other sectors under section 111(d) of the Clean Air Act. For the present, though, there appears little prospect of major federal climate action.

New Techology – Technological advances could help achieve further reductions by lowering the cost of cleaner energy sources or energy efficiency improvements, or by opening other options for reducing emissions. Examples include:

- Over the next five to 10 years, battery storage technologies are expected to improve by a factor of 10 and transform the U.S. electric power grid.[38,39] Integrated in the right way, storage technology could reduce emissions from fossil-fuel "peaker" plants and support the integration of greater quantities of intermittent renewable generation.
- A promising design for a natural gas power plant with nearly 100 percent carbon capture will enter the demonstration phase later this year and could be commercialized soon after.[40]
- Agricultural advances are leading to the development of more sustainable crops with the ability to sequester larger quantities of carbon dioxide in their root systems.[41]

State Action – In the absence of federal action, states could intensify their climate initiatives. Carbon pricing exists in California and nine Regional Greenhouse Gas Initiative (RGGI) states in the Northeast. States including Oregon, Virginia, and Washington are considering carbon pricing. Expanding the number of participating states and/or the extent of carbon-pricing policies (e.g., including additional economic sectors) could accelerate carbon dioxide reductions.

A recent report from the U.S. Climate Alliance projects that the 14 member states (California, Colorado, Connecticut, Delaware, Hawaii, Massachusetts, Minnesota, New York, North Carolina, Oregon, Rhode Island, Vermont, Virginia, Washington) and Puerto Rico are "collectively on track" to reduce their emissions 24 to 29 percent below 2005 levels by 2025, effectively meeting and potentially exceeding their share of the U.S. NDC.

Many states continue to advance policies that reduce carbon emissions for reasons other than climate change. As clean energy sources become more cost-effective, jurisdictions are promoting clean energy to drive economic growth, local industries, and jobs. For example, 29 states and the District of Columbia have renewable

portfolio standards (RPSs) that require utilities to deliver a certain percentage of their electricity from renewable sources (e.g., wind, solar, small hydro). Several states have recently increased the ambition of their RPSs (e.g., California, Maryland and New York).

Most states, including Florida, Ohio, and Pennsylvania, offer policy or financial support for the purchase of electric vehicles. States including Texas and Louisiana have created favorable policy environments for carbon capture from electric power plants and industrial facilities, and innovative projects are under development. States like Connecticut, Illinois, New Jersey, New York, Pennsylvania, and Ohio are taking steps to preserve their existing nuclear power plants. Stronger mitigation efforts in the 10 states accounting for half of all U.S. CO_2 emissions (i.e., California, Florida, Illinois, Indiana, Louisiana, Michigan, New York, Ohio, Pennsylvania and Texas) could achieve substantial reductions by 2025.

CONCLUSION

Thanks to a mix of market, technology and policy drivers, the United States has significantly reduced its greenhouse gas emissions over the past decade. Although the new administration will likely revise or reverse key federal climate policies, there remains strong momentum toward further reductions in U.S. emissions. Assuming the administration does in fact roll back key policies, projected reductions in energy-related CO_2 and in non-CO_2 emissions, plus a conservative estimate of additional reductions resulting from city and business actions, will put net U.S. emissions at about 14 percent below 2005 levels in 2025. Factoring in as well 1) a less conservative estimate for actions by cities not captured by emissions models, and 2) an optimistic forecast for land use sequestration, suggests further reductions, to nearly 18 percent below 2005 levels by 2025.

Far greater reductions are needed to put the United States on a path to the deep decarbonization required by mid-century to avert warming greater than 2 degrees Celsius above pre-industrial levels. Even in the absence of additional federal action, stronger efforts by states, cities and businesses can produce further emission reductions by 2025. For instance, a recent decision by RGGI states establishing a 2030 target will likely drive additional near-term reductions, and a number of other states are actively considering establishing or strengthening carbon pricing policies or renewable portfolio standards. Over the longer term, policies supporting electric vehicles and accompanying infrastructure, carbon capture, and advanced nuclear power can help move the United States closer to a deep decarbonization pathway.

A wide range of feasible options could enable the United States to come closer to its original Paris goal (reducing emissions 26 to 28 percent below 2005 levels by 2025) than currently forecast. While comprehensive federal policy must remain an overriding objective, the immediate challenge falls primarily to states, cities and businesses. Helping these actors track their emissions, and set and achieve their goals, will ensure continued progress toward avoiding the worst effects of climate change.

ENDNOTES

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19 Note that a recent decision from the U.S. Court of Appeals vacated EPA's authority to ban HFCs under the Clean Air Act Section 612 (i.e., under the Significant New Alternatives Policy (SNAP) program); however, the decision noted that EPA likely has other pathways (e.g., the Toxic Substances Control Act) to regulate and phase-down HFCs. This verdict will likely affect the phase-down timeline, but we assume that they will still occur before 2025.

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2101 WILSON BLVD. SUITE 550 ARLINGTON, VA 22201 703-516-4146 **C2ES.ORG**