

America First: carbon emissions go last?

Potential impact of President Trump's "America First Energy Plan" on the power sector



The Trump administration's approach to the traditional energy trilemma (the challenge of balancing the goals of cheap, secure and clean energy) appears set to skew heavily towards the low cost and secure aspects of energy supply at the expense of any focus on carbon emissions. While federal legislation, such as the Clean Power Plan (CPP), and U.S. commitment to the Paris Agreement (COP-21) may fall casualty to anticipated policy actions, our analysis shows the future for carbon emissions will not be as gloomy as many fear – largely due to the trajectory the power sector is already firmly on.

Decarbonization: a policy of the past in the U.S.?

The December 2015 Paris Agreement was seen as a landmark for decarbonization: policy makers the world over, including the chief emitters, China and the U.S., agreed a deal to strengthen the worldwide response to climate change. To date, 127 out of 197 Parties have ratified the Agreement.

The Obama Administration approved the Paris deal in September 2016. The U.S. target for greenhouse gas emission reductions currently stands at 26 to 28% below 2005 levels by 2025. The main federal energy policy measure to deliver this decrease in carbon was Obama's Clean Power Plan (CPP), which sought to reduce emissions from the power sector by 30% by 2030.

With the Trump Administration now in the White House, the CPP is unlikely to be implemented. U.S. energy policy will be replaced with the "America First Energy Plan". It may only be a high-level summary at this stage (March 2017), but the focus has clearly shifted away from low carbon; the emphasis is now on low cost supply and utilizing domestic energy sources, specifically coal, shale oil and shale gas.

There is no doubt that there is an abundance of coal, oil and gas in the U.S. Unconventional production methods have been a game-changer, and technology improvements continue to reduce the cost of extraction. Renewable power can also be a cost-competitive energy source, and an additional provider of domestic energy supply and potential economic growth (a view supported by energy giants such as Shell, which recently reiterated its intention to invest beyond fossil fuels). But there is no clear mention of either increasing renewable generation capacity or in limiting greenhouse gas emissions in the current version of the Plan (although clean air and water are included). Trump's new policies, despite calls from the E.U. and China not to abandon the decarbonization goal, seem to be a major shift in recent U.S. policy, and a potential U-turn away from the initial commitment on climate change.

In this Viewpoint, we consider whether significant reductions in carbon emissions can still be achieved if Obama's Clean Power Plan is disregarded, and then under a possible Trump "America First Energy Plan" scenario. In essence, what happens to U.S. emissions in the power sector without continued support for renewables? Will natural gas, the cleanest of the fossil fuels, compete against coal to continue to deliver a reduction in U.S. greenhouse gas emissions?

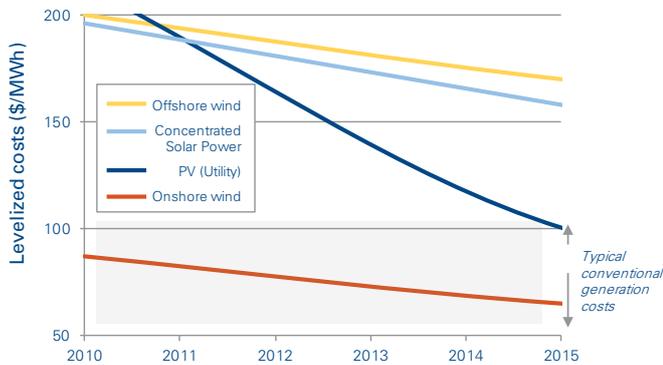
Major progress towards the “renewables plus natural gas” model has already been made

We continue to believe that a higher renewables world, supported by natural gas, remains a plausible low cost, low carbon, secure energy future for the U.S.

Renewable energy sources have out-performed all expectations – in terms of costs...

The cost of renewables has dropped far faster than anyone expected, e.g. by over 70% in the last 5 years for solar PV, and by 15-25% for onshore and offshore wind. PV and onshore wind are now competitive with conventional power sources in many areas of the U.S. (on a levelized cost basis, and without subsidy) and costs continue to reduce.

Figure 1. Recent evolution of selected renewable technologies (excluding tax credits and subsidies)



Source: EIA, NREL, IRENA, Arthur D. Little

...in terms of capacity

The Energy Information Administration (EIA), and other institutions, have historically hugely underestimated the growth of solar PV and wind, particularly PV. For example, the 2011 Annual Energy Outlook (AEO) projected a 2035 PV installed capacity level which had already been exceeded by 2013. The latest AEO reports have significantly upgraded the renewables growth forecast, with capacity now expected to double by 2040, though these figures still look conservative based on recent developments in an industry where installed capacity increased by 30% in the last five years.

...and in terms of grid integration issues

A fear often highlighted for large scale integration of renewables is the need for substantial quantities of spinning reserve as “back-up” to maintain system balance. There are additional costs from maintaining reserve plant and/or storage, plus the extra network reinforcement costs to cope with fluctuations in supply from more widely dispersed renewable generation assets.

Our review suggests that the total back-up capacity required is relatively modest, at around 5% for 33% renewables

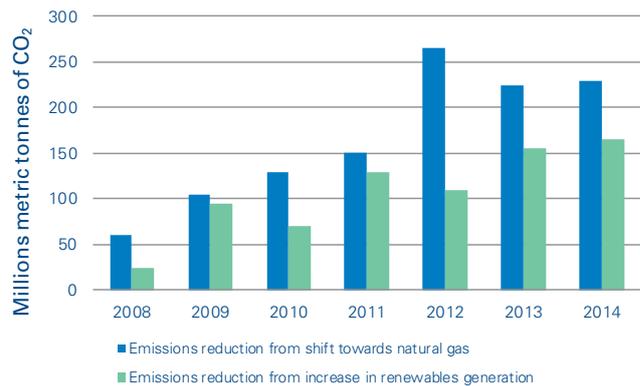
penetration, and could be around 10% for 50% penetration. This back-up capacity can be provided by a mix of peaking plant, storage and demand-side response.

Natural gas has driven recent U.S. emissions reductions, despite the growth in renewables

Natural gas contains less carbon per energy unit than coal, and the power production process is itself more efficient; emissions of CO₂ per TWh of electricity produced using natural gas are less than half those from coal.

The abundance of low cost natural gas has already played a substantial part in the efforts to reduce greenhouse gas emissions in the U.S., mainly via the replacement of older coal-fired power stations. The emissions impact of coal switching to natural gas in the power sector outweighs the impact of renewables to date.

Figure 2. Historical emission reductions from natural gas and renewables



Source: EIA

Despite recent decreases in installed capacity and output, coal-fired generation remains a major component in the mix, leaving significant headroom for coal replacement by natural gas and further emissions reductions.

Natural gas turbines also combine relatively low cost, high capacities, and high ramp rate capability, giving them the flexibility to complement renewables. They therefore play a critical role in enabling faster renewables growth.

Our scenario analysis shows emissions continue to reduce

EIA base scenarios

The EIA publishes an annual, detailed forecast of the energy sector in the U.S. In its Annual Energy Outlook 2017, it shows the impact of the Clean Power Plan on emissions. Figure 3 below shows the emissions forecasts for the power generation sector, for various scenarios.

The top of the red shaded area shows the EIA's most recent forecast of power sector emissions, assuming no CPP. The top of the blue shaded area shows the same forecast assuming the CPP continues.

In the early years, the EIA shows some uncertainty as to how quickly carbon emissions will fall, dependent on whether there is more or less switching to natural gas, whether oil prices increase or remain at current levels, and their subsequent impact on economic growth. This is represented in the chart below by the overlapping blue and red shaded areas from 2015 to 2025.

According to the EIA's estimates, emissions under the CPP are 17% lower in 2030 compared with the no-CPP case, or down 39% on 2005 levels. This is substantially higher than the CPP target of a 30% reduction on 2005 levels.

A "Deep Decarbonization" scenario

To demonstrate the potential for further emissions reductions from the power sector in the U.S. if focused political will were deployed (including the relevant subsidies, tax breaks, regulations and R&D support) we have constructed a low carbon scenario based on the EIA's data.

In this scenario, large, high emission, centralized coal plant would be rare, and instead, the power network would consist of an array of smaller, more efficient and highly distributed generation assets. Solar PV panels and wind turbines would be commonplace and storage technologies, at all scales, widely deployed. Renewables penetration would be 44% by 2035.

Demand side management, energy efficiency measures and smart grid deployment would also continue to grow.

Crucially, in the background of any low carbon scenario, supporting the growth of renewables, would be fast-ramping gas turbines (OCGT or CCGT or a mix) supplying both a large percentage of centrally produced power, and playing a critical role in stabilizing the grid and balancing fluctuations in renewable power output. Optimization and aggregation of the assets available to the system would become key, in place of centralized dispatch.

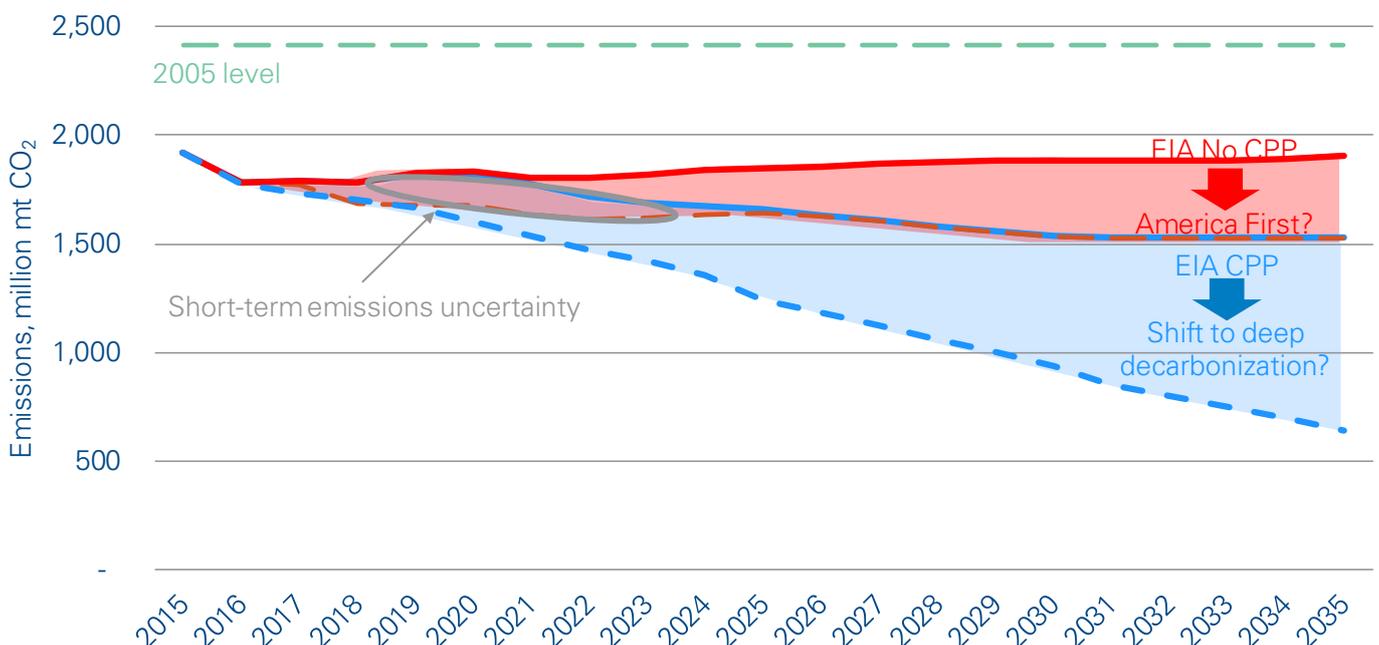
The results of our "Deep Decarbonization" scenario are shown by the lowest blue line in Figure 3. Our analysis suggests that 2030 emissions could be a further 36% below the CPP case (or over 60% less than 2005 emission levels), representing a substantial shift towards a low carbon future in the U.S. power sector.

"America First Energy Plan" scenarios

Despite the significant potential to reduce emissions in the power sector, the only indication that the America First Energy Plan will consider carbon emissions in future policy is the mention of clean coal technologies, which for cost and fuel efficiency grounds have mostly failed to progress beyond pilot projects in the last decades.

Yet our analysis suggests that significant emissions reductions can occur in any event, due to a combination of factors:

Figure 3. Emissions in the U.S. power sector, with and without the CPP



Source: EIA Annual Energy Outlook 2017, Arthur D. Little

- 1. Previous government policy has already set the wheels in motion:** renewables were promoted, capacity has been built, infrastructure has been strengthened, more projects are under development, and costs have fallen. At least in the short term, it is hard to see how the trajectory will stall.
- 2. State-level policies may continue to promote renewables,** even if the CPP and federal level support is removed. For example, California passed law SB-32 in 2016, which aims to reduce carbon emissions to 40% below 1990 levels by 2030. As the world's sixth largest economy, Californian policy will have a notable effect on U.S. emissions.
- 3. Natural gas will continue to displace coal.** Natural gas is the critical enabler of the low carbon economy, at least in the mid-term. And the shale gas revolution means there will be plenty of low cost gas in North America for the next few decades, even if significant volumes of gas are exported.

In Figure 3, the lower red line represents a possible "America First" emissions forecast for the power generation sector. In this scenario, we have assumed that renewables growth stalls post 2020, nuclear capacity remains stable, and natural gas continues to displace coal over the next 20 years. We have also assumed that electricity demand is equal to the EIA reference case. Using these assumptions, we forecast 2030 carbon emissions to be 13% below the no-CPP case (or 36% below 2005 levels). This is perhaps an optimistic case, with reality likely somewhere within the red shaded area in the chart, but it illustrates the clear potential to reduce emissions.

With reduced regulation, the market decides

As President Trump's energy policy is fleshed out further scenarios will emerge. Currently it appears likely that support for renewables will end, and fossil fuels will have to compete amongst themselves on a level playing field.

The logical outcome, with all energy sources competing on an economic basis, is that in the short-term coal and gas take turns as the cheapest power source on the basis of price fluctuations in each fuel, with regional variations. Choices for new investment, as they look over the longer-term, will be focused on natural gas and renewables, given that the LCOE for coal with carbon capture is double that of gas-fired combined cycle, solar PV and onshore wind.

The Trump administration will most likely reduce federal level support for decarbonization of the power sector. Despite this, our analysis suggests that carbon emissions will continue to reduce, suggesting that an economic tipping point in favor of low carbon technologies has already been reached.

Contacts

Rodolfo Guzman

guzman.rodolfo@adlittle.com



Stephen Rogers

rogers.stephen@adlittle.com



Authors

Yvonne Fuller, Kirsty Ingham, Paola Carvajal

Arthur D. Little

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