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HIGH COST OF CEPP IN WEST VIRGINIA

The Clean Electricity Performance Program Would Cost West Virginia an Additional $34.9 Billion

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CONTENTS

Executive Summary

The Clean Electricity Performance Program (CEPP) advanced by Congressional Democrats as part of the proposed $3.5 trillion reconciliation package would have required electricity providers to increase the amount of carbon-dioxide-free electricity sold on their systems by 4 percent every year or pay penalties.

Media reports indicate that the CEPP may no longer be part of the reconciliation package due to the objections of West Virginia Senator Joe Manchin.[1]

The removal of the CEPP from the reconciliation package is undeniably good news for Senator Manchin's constituents because the proposal would have significantly increased the cost of electricity for West Virginia families and businesses, even if it had been amended to allow carbon capture and sequestration (CCS) equipment on coal plants or allowed unabated natural gas (UNG) to substitute for coal in an attempt to win Manchin's approval.[2,3]

Center of the American Experiment (American Experiment) has conducted a cost analysis of complying with the CEPP under three different scenarios; a Renewable scenario, where wind and solar are used to meet carbon-free requirements, a CCS scenario, where existing coal-plants in West Virginia are retrofitted with CCS technology, and a UNG scenario, where natural gas is allowed to substitute for coal-fired generation.

Achieving CEPP targets in West Virginia under the Renewable, CCS, and UNG scenarios would cost an additional $34.9 billion, $24 billion, and $6.1 billion, respectively (in constant 2021 dollars) compared to operating the current electric grid.[4] Rising costs would cause electricity prices to increase by 25 percent in 2031 in the Renewable scenario, 22.5 percent for the CCS scenario, and 8 percent for the UNG scenario, compared to 2019 rates.

If borne by residential, commercial, and industrial electricity customers in West Virginia, rather than federal taxpayers, the additional costs imposed by the CEPP would be more than $1,100 per customer, $760 per customer, and $190 per customer per year through 2052 for the Renewable, CCS, and UNG scenarios, respectively.[5]

Higher electricity prices would lead to higher costs for all West Virginians, but low-income households would be disproportionately hurt because these families spend a higher percentage of their income on energy bills relative to other West Virginia households.

West Virginia would also be harmed by meeting CEPP objectives under the Renewable scenario because it is a large exporter of coal-fired electricity supplied by West Virginia coal mines. As a result, a forced transition to wind and solar electricity would be a one-two punch to West Virginia's economy by increasing the cost of electricity and destroying thousands of high-paying coal mining jobs in the state.

The CCS scenario could potentially increase the number of coal mining jobs in the state. The UNG scenario would likely create jobs in the natural gas industry because West Virginia is a large producer of natural gas— thanks to hydraulic fracturing (aka fracking). Rising natural gas industry jobs could help offset some of the jobs lost in the coal industry. ■

Introduction

West Virginia is a state that has always revolved around energy. It is the fifth-largest energy producing state, generating 5 percent of the total energy in the United States.[6] West Virginia's abundance of natural resources means many residents have depended on jobs in the energy industry to pay the bills.

In the 1920s, coal employment in West Virginia rose to well over 800,000 jobs. Today, slightly more than 13,000 remain.[7] Central Appalachia, encompassing all of West Virginia, has reduced output from 234 million tons in 2008 to 93 million tons in 2019.[8]

These declines did not happen by accident. Many people believe replacing coal and natural gas-fired power plants with wind turbines and solar panels will spur economic growth and that this transition will be easy to accomplish because wind and solar are "free" electricity sources.

However, these energy sources are not free. Moreover, maintaining a reliable electric grid becomes increasingly difficult—and expensive—as reliance on wind and solar power increases over time.[9]

Proponents of renewable energy mandates routinely ignore the large, up-front capital costs associated with building wind turbines, solar panels, and transmission lines.

Proponents of renewable energy mandates routinely ignore the large, up-front capital costs associated with building wind turbines, solar panels, and transmission lines. They also ignore the resulting cost increases in property taxes, utility profits, and load balancing—or providing electricity when the wind is not blowing or the sun is not shining, either with backup natural gas facilities or battery storage. These are all major expenses of maintaining a reliable electric grid with large amounts of wind and solar capacity.

Our study accounts for each of these factors, and therefore provides a comprehensive and realistic picture of the cost of providing reliable electricity while implementing the CEPP. ■

Section I: What Was the CEPP?

The Clean Electricity Performance Program (CEPP) was one of the most sweeping energy proposals in American history.

This proposal—which was advanced by Congressional Democrats as part of their proposed $3.5 trillion reconciliation package—would have acted as a de facto renewable energy mandate and carbon tax in the United States by requiring electricity providers to increase the amount of low-carbon electricity generated every year. If they did not comply, they would have been subject to fines.

The CEPP would have required electric companies to increase the amount of "clean" electricity, defined as energy sources producing less than 0.1 tons of carbon dioxide per megawatt-hour (MWh) generated, by 4 percent each year, relative to the previous year.

Companies that achieved these goals would have received payments in the amount of $150 per MWh of clean electricity generated.[10] Companies that did not meet this target would have faced fines of $40 per MWh if they failed to increase the amount of carbon-free electricity generated by 4 percent each year.

This proposal would have acted as a de facto renewable energy mandate and carbon tax in the United States by requiring electricity providers to increase the amount of low-carbon electricity generated every year.

While the language of the CEPP was technically broad enough to incentivize the construction of a wide variety of low-carbon and no-carbon resources, such as CCS equipment and new nuclear power facilities, in practice, the requirement for a 4 percent increase in annual "clean" electricity generation precluded these resources because there was no realistic timeline for these technologies to meet CEPP requirements.[11]

Further, the CEPP did not allow for averaging of clean energy sources over the course of several years. This further disincentivized the construction of large nuclear power plants and CCS units in favor of wind, solar, and battery technology, which are better suited to meet these incremental mandates.

For the purposes of this study, we assumed

CCS and UNG would be allowed reasonable timelines for installation and that emissions reductions from these facilities could be averaged over the duration of the CEPP.

Proponents of the CEPP claimed the proposal would decrease the cost of electricity by shifting the cost of generating and maintaining electric infrastructure from ratepayers to federal taxpayers.

Rather than attempt to allocate CEPP compliance costs based on complicated federal formulas that could have been subject to change during the legislative process, this analysis calculated the complete cost of complying with the CEPP without factoring in federal subsidies for wind turbines, solar panels, or carbon capture equipment. Additionally, it did not account for CEPP payments and penalties. We believe this methodology is appropriate because federal subsidies would not reduce the cost of complying with this proposal, they would simply shift who pays for it.

The appendix explains the assumptions and factors taken into account by our model. ■

Section II: West Virginia's Electricity Mix Before and After CEPP

In 2019, West Virginia derived 91 percent of its electricity generation from coal, 3.5 percent from natural gas, 2.7 percent from hydroelectric plants, and 2.6 percent from wind installations located in the state (See Figure 1).[12]

Combined, hydroelectric and wind—which do not produce carbon-dioxide emissions—represented 5.2 percent of the electricity generated in West Virginia in 2019. Under the CEPP, the generation mix would have shifted significantly.

Renewable Scenario

The Renewable scenario calculates the generation mix and cost of CEPP compliance in West Virginia using wind and solar generation. Figure 2 shows West Virginia's electricity mix in 2031 under this scenario.

Battery storage is not built in this scenario because it is more affordable to "back up" wind and solar with new natural gas plants than to build battery storage. Instead, wind turbines and solar panels are "overbuilt" to meet the CEPP requirements and curtailed, or turned off, during periods of high wind or solar output to prevent the grid from being overloaded with electricity.[13]

Under the Renewable scenario, 31 percent of West Virginia's electricity would come from wind, 9 percent from solar, 3 percent from hydroelectric plants, 21 percent from natural gas, and 36 percent from coal-fired power plants.[14] This generation mix is held constant through 2052 to prevent emissions from increasing after the CEPP expires in the early 2030s.[15]

CCS Scenario

Under the CCS scenario, four existing coal plants in West Virginia are retrofitted with CCS technology which becomes active before the CEPP expires in the early 2030s.[16] Figure 3 shows West Virginia's electricity mix under this scenario.

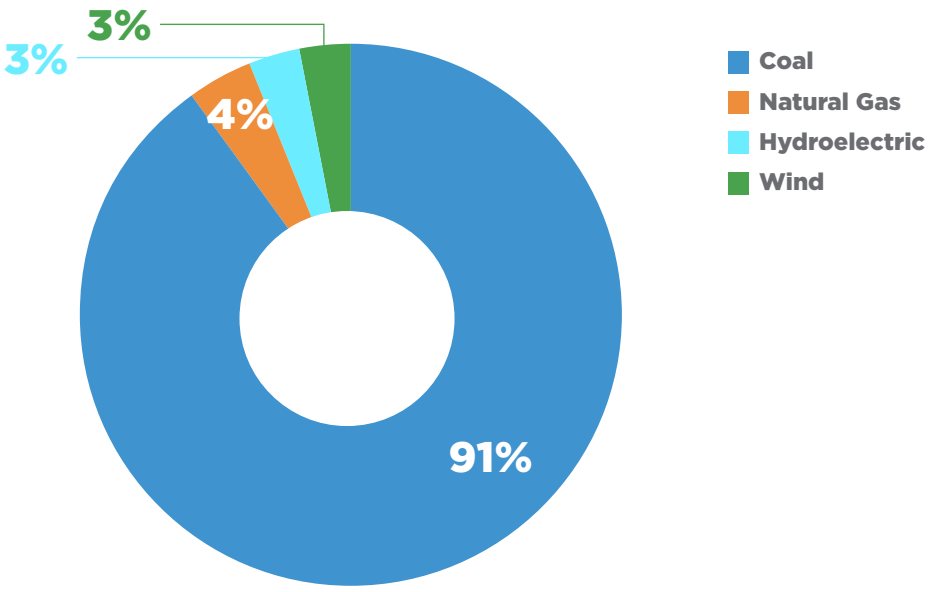
In this scenario, 3 percent of West Virginia's electricity would be generated by wind, 3 percent from hydroelectric plants, 11 percent from natural gas, 47 percent would be generated at coal-fired power plants, and 36 percent would come from coal plants with CCS technology. As a result, 42 percent of West Virginia's electricity would come from carbon-dioxide free sources.

UNG Scenario

Under the UNG scenario, natural gas power plants displace a significant quantity of the electricity generation currently provided by existing

FIGURE 1

West Virginia Electricity Generation by Source in 2019

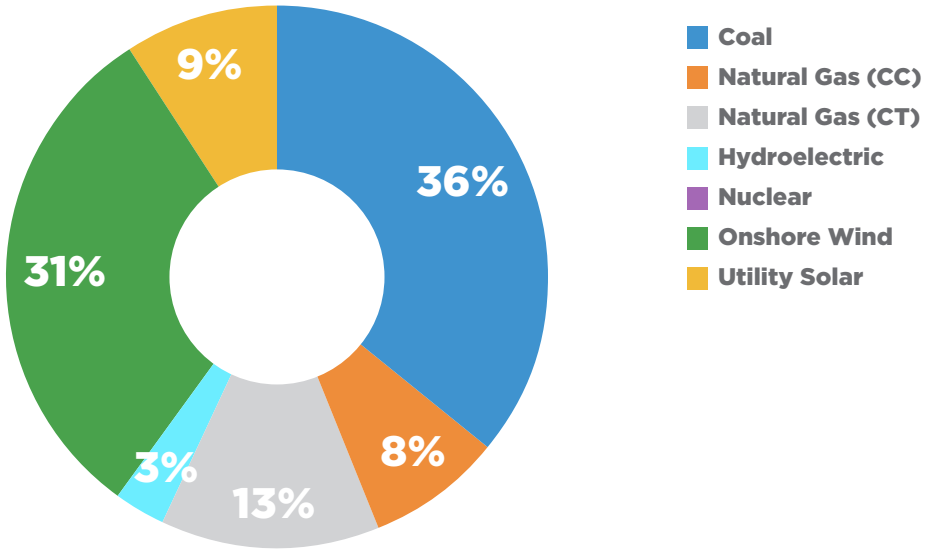


SOURCE: EIA STATE ELECTRICITY PROFILES

FIGURE 2

West Virginia Generation by Energy Source: 2031 Renewable Scenario

Under the Renewable scenario, coal would provide 36 percent of West Virginia's electricity, wind would provide 31 percent, natural gas would provide 21 percent, solar would provide 9 percent, and hydroelectric would generate 3 percent in 2031.

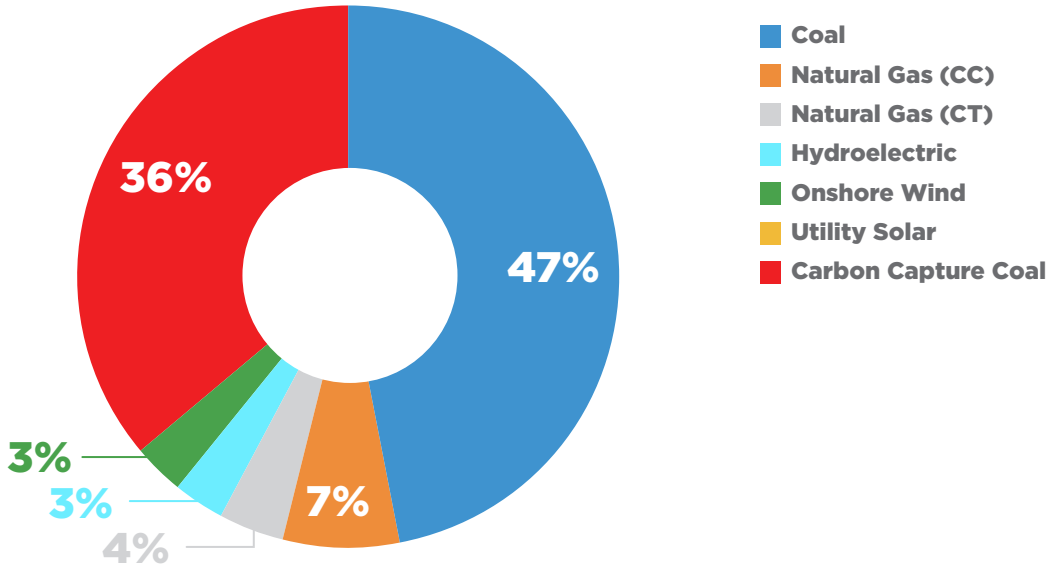


SOURCE: AMERICAN EXPERIMENT MODELING

FIGURE 3

West Virginia Generation by Energy Source: 2031 CCS Scenario

Coal without carbon capture and sequestration equipment continues to be the largest source of electricity in this scenario, but CCS-coal provides 36 percent of the electricity generated in West Virginia by 2031.



SOURCE: AMERICAN EXPERIMENT MODELING

coal plants in West Virginia. Figure 4 shows the resource mix in 2031 under this scenario.

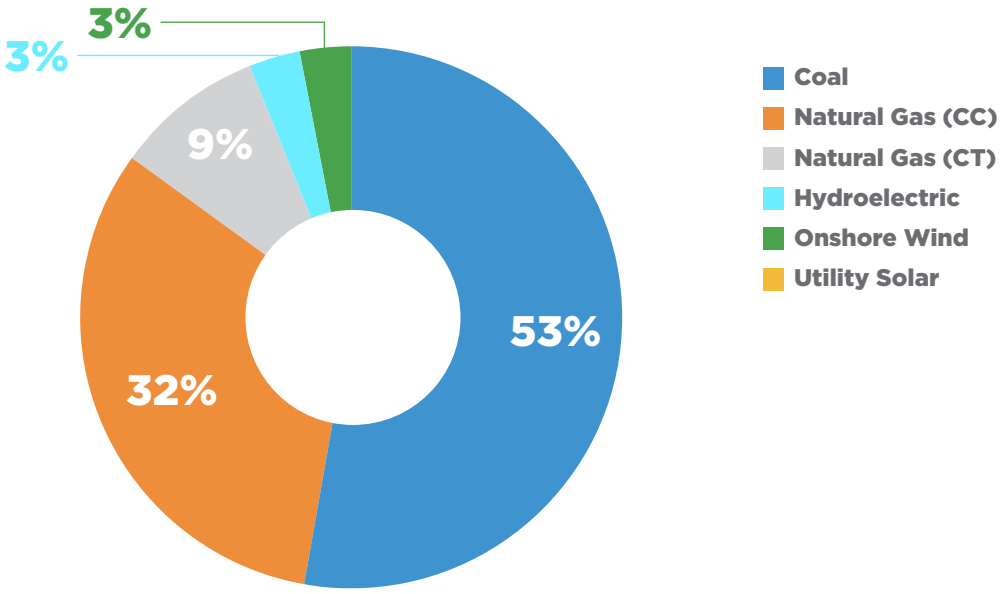
In the UNG scenario, 3 percent of West Virginia's electricity would be generated from wind, 3 percent from hydroelectric plants, 41 percent from natural gas, and 53 percent would still be generated at coal-fired power plants in 2031. This resource mix would continue until 2052.

The changing electricity generation mix under each of these scenarios would have a profound impact on the cost of power for West Virginia families and businesses. ■

FIGURE 4

West Virginia Generation by Energy Source: 2031 UNG Scenario

In the UNG scenario, natural gas is substituted for coal to generate 41 percent of West Virginia's electricity in 2031.



SOURCE: AMERICAN EXPERIMENT MODELING

Section III: Comparing the Cost of the CEPP Under Three Scenarios

The cost of implementing and meeting the goals established under the CEPP would have varied widely depending on each scenario. Our results show the Renewable scenario would have been the most expensive, followed by the CCS scenario, with the UNG scenario having the lowest cost compared to operating the current electric grid in West Virginia.

Each of these scenarios assumes electricity generation in West Virginia would remain constant at approximately 64 million MWhs from 2021 through 2052.[17,18] This assumption is conservative because proponents of the CEPP also promoted the widespread adoption of electric vehicles and the broader electrification of the energy sector. These actions would require significant increases in the amount of electricity generated every year.

This study does not quantify the additional costs associated with rising levels of electrification because it is designed to show the difference in cost to serve the same amount of electricity demand as the current grid, providing an apples-to-apples comparison of the cost of electricity in West Virginia with, and without, the CEPP.

Our results show the Renewable scenario would have been the most expensive, followed by the CCS scenario, with the UNG scenario having the lowest cost...

Renewable Scenario

The Renewable scenario would cost an additional $34.9 billion in West Virginia, compared to operating the current electric grid, resulting in a 25 percent increase in electricity prices by 2031, compared to 2019 rates.

These significant spending increases translate into an average increase in electricity costs of more than $1,100 per customer per year through 2052. Industrial companies in West Virginia, as large users of electricity, would be hit hard, with electricity bills increasing by more than $15,600 per year on average through 2052.

CEPP compliance costs in the Renewable scenario are driven by the need to build enough solar panels, wind turbines, new natural gas plants, and transmission lines to meet the carbon-dioxide-free electricity requirements in the program while still maintaining grid reliability.

Other factors that increase costs in the Renewable scenario include increasing property taxes, utility returns, and maintaining the reliable power plants needed to provide electricity when the sun is not shining and the wind is not blowing. These are referred to as "load balancing" costs, and they are often ignored.

If new 4-hour lithium-ion battery storage facilities were built instead of these new natural gas plants, the cost of the Renewable scenario would increase to $41.7 billion, causing electricity rates to increase by 33 percent, representing an annual average increase of over $1,300 per customer.

This resource mix would also be less reliable than using natural gas as a load balancing resource because the batteries would only last for 4 hours. In contrast, natural gas plants can run as long as needed, provided they have enough fuel.

CCS Scenario

The CCS scenario would cost an additional $24 billion in West Virginia, compared to operating the current electric grid, resulting in a 22.5 percent increase in electricity prices by 2031, compared to 2019 rates.

This translates into an average increase in electricity costs of more than $760 per customer per year through 2052. Industrial companies in West Virginia would see their electric bills increase by more than $10,750 per year on average through 2052.

Costs are less under this scenario because it costs less to retrofit the existing coal plants with CCS equipment than the capital expenditures needed to build enough wind turbines, solar panels, transmission lines, and new natural gas to comply with the CEPP and maintain a reliable grid.

Lower capital expenditures result in fewer expenses for utility returns and property taxes, and reliable, dispatchable power plants do not require "back up" power plants to solve the problems inherent with the intermittency of wind turbines and solar panels.

However, fuel expenditures increase in this scenario because capturing the carbon-dioxide emissions from coal plants requires approximately 33 percent of the electricity generated by the plant. This is known as "parasitic load," and it increases the cost of providing electricity to the families and businesses that rely upon it.

UNG Scenario

The UNG scenario would cost an additional $6.1 billion in West Virginia, compared to operating the current electric grid, resulting in an 8 percent increase in electricity prices by 2031, compared to 2019 rates.

This translates into an average increase in electricity costs of $190 per customer per year through 2052. Industrial companies in West Virginia would see their electric bills increase by more than $2,700 per year on average through 2052.

Costs are lowest under this scenario because it costs less to build and operate new combined-cycle natural gas plants than to retrofit existing coal plans with CCS equipment. Fewer capital expenditures result in fewer expenses for utility returns and property taxes, and unabated natural gas plants would not suffer from the problem of parasitic load that accompanies the installation of CCS technologies on existing coal plants.

Rising Prices for a Changing Grid

The CEPP would have required large changes to the types of power plants that currently generate West Virginia's electricity. Figure 5 shows West Virginia's electric grid in 2019 and compares it to the resource mix in each of the three scenarios modeled.

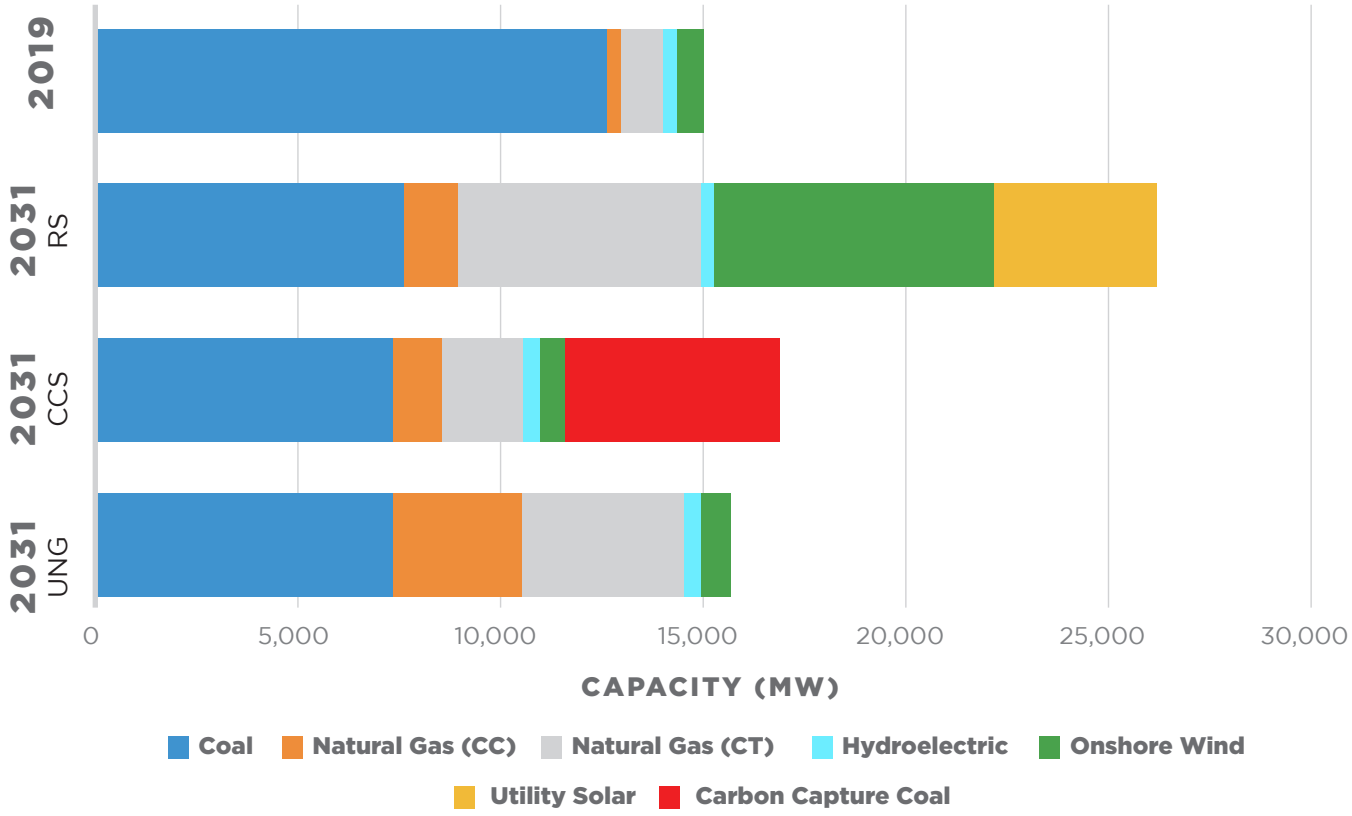
In 2019, West Virginia had just under 15,000 MW of installed power plant capacity on the grid. Under the Renewable scenario, installed capacity would increase by a net of 11,000 MW to 26,000 MW. In contrast, in the CCS and UNG scenarios, the amount of capacity on the system would remain about the same, but the types of power plants generating electricity would change (See Figure 5).

While these changes may sound like a good thing, increasing capacity or changing the resource

FIGURE 5

Total Capacity By Energy Source - Comparison

In the Renewable scenario (RS), the total installed capacity would nearly double to meet the criteria established by the CEPP. Wind capacity would increase 10-fold, from 686 MW in 2019 to 6,860 MW in 2031. The CCS and UNG scenarios would increase costs by changing the type of power plant capacity used to meet the current electricity demand.



SOURCE: EIA STATE ELECTRICITY PROFILES, AMERICAN EXPERIMENT MODELING

mix merely to meet mandates, rather than meeting demand, is an unnecessary cost that will harm West Virginia families and the state's economy.

In the Renewable scenario, solar, wind, and new natural gas capacity increase while coal-fired capacity on the grid decreases. Building these solar panels, wind turbines, and new natural gas facilities would cost $7.6 billion, $17.2 billion, and $4.3 billion, respectively.

Natural gas plants, rather than battery storage facilities, are used to generate electricity during periods of low wind and solar output.[19] Because West Virginia has very little carbon-dioxide free electricity on its electric grid already, natural gas and curtailing excess wind and solar become the most economical way of meeting CEPP targets. While this may seem wasteful, curtailment is expected to become increasingly common as more wind and

solar are placed into service on the grid.[20].

In the CCS scenario, 5,232 MW of coal-fired capacity is retrofitted with CCS technology at the cost of $7.5 billion. In the UNG scenario, 6,050 MW of natural-gas fired capacity is built to replace 5,232 MW of capacity at existing coal plants at the cost of $4.7 billion.

Transmission Costs

Transmission lines are important: It does no good to generate electricity if it cannot be transported to the homes and businesses that rely upon it. Implementing the CEPP in West Virginia under the Renewable Scenario would require $2 billion in additional transmission spending compared to the current system.[21] The CCS and UNG scenarios, in contrast, utilize dispatchable facilities that do not require the same large buildouts of additional transmission infrastructure.

Costs for transmission lines in the Renewable scenario are higher because the National Renewable Energy Laboratory (NREL) estimates that achieving a grid powered by 40 percent solar and wind in the United States would require the construction of approximately 25 million MW miles of transmission lines, which is about 12.5 percent of the total quantity of transmission lines installed nationally.[22] Assuming similar increases in transmission lines would be needed for each state, West Virginia's grid—which would be powered by 41 percent solar and wind under the CEPP—would require an approximately 12.5 percent increase in transmission lines.

According to the U.S. Department of Energy, West Virginia has 2,941 miles of transmission lines that are 345 kilovolts (kV) or larger, and 490 miles of transmission lines that are less than 230 kV.[23] According to our assumptions based on NREL estimates, West Virginia would require 367 miles of new 345 kV lines, and 61 miles of new 115 kV transmission lines, to accommodate more wind and solar power.

Transmission lines routinely cost between $2.5 million per mile for 115 kV lines and $5.2 million per mile for 345 kV lines.[24] As a result, building enough transmission lines to comply with the CEPP would cost $2 billion in the Renewable scenario.

Utility Returns

Because investor-owned utilities (IOUs) such as Appalachian Power Company, Wheeling Power Company, etc. are regulated monopolies in West Virginia, they are not allowed to make a profit on the electricity they sell.

Instead, they make a government-approved profit of 9.75 percent when they spend money on capital assets such as power plants, transmission lines, and even new corporate offices.[25]

The CEPP would have required utilities to spend billions of dollars on new infrastructure. Our analysis assumes all new capacity is built by investor-owned utilities and subject to utility returns.

Additional utility returns would be highest in the Renewable scenario at $23.4 billion. Utility returns are highest in this scenario because it would require electric companies to spend the most money on wind turbines, solar panels, new natural gas facilities, and transmission lines.

Utilities would earn fewer returns in the CCS and UNG scenarios at $11.4 billion and $6.3 billion, respectively. Utility returns are lower because these scenarios require electric companies to spend much less on power plants than the Renewable scenario.

Property Taxes

Property taxes increase most under the Renewable scenario of the CEPP because compared to the current grid, CCS, and UNG scenarios, there is much more property to tax. While the property taxes assessed on power plants are often a crucial revenue stream for local communities that host power plants, these taxes also effectively increase the cost of producing and providing electricity for everyone.

Additional property tax payments under the Renewable, CCS, and UNG scenarios were calculated to be $6.1 billion, $2.9 billion, and $1.6 billion, respectively.[26] ■

Section IV: High Energy Costs Harm Families and the Economy

Proponents of the CEPP argued that increasing the use of wind and solar power would benefit the nation's economy. They were wrong. Increasing the cost of electricity does not grow the economy, it simply transfers into the electricity sector money that would have been spent elsewhere.

If CEPP compliance costs—especially those associated with the Renewable scenario—were paid by West Virginia ratepayers instead of federal taxpayers, the billions of dollars spent on new solar panels, wind turbines, transmission lines, and new natural gas plants would have imposed significant additional electricity costs on each West Virginia electricity customer.

Average additional costs would be more than $1,100 per customer per year through 2052 in the Renewable scenario, $760 in the CCS scenario, and $190 in the UNG scenario.[27] Rising electricity costs mean West Virginians would have less money for rent or mortgage payments, healthy food for their families, healthcare for their children, or saving for a rainy day.

Many residents across the Mountain State already struggle to make ends meet. To date, 16 percent of the population lives in poverty, and low-income households would have been hurt most by rising electricity costs because they spend a higher percentage of their income on energy bills than other West Virginia households.

Data from the U.S. Department of Energy's Low-Income Energy Assistance Data (LEAD) program show a significant number of West Virginia residents already spend between 5 and 6 percent of their income on energy, with three counties spending at least 6 percent of their income on energy costs (See Figure 6).[28]

By increasing energy costs on West Virginia consumers, the CEPP would have increased the cost of essential services like refrigerating food and medicine, home heating, and air conditioning.

Broader Economic Impacts

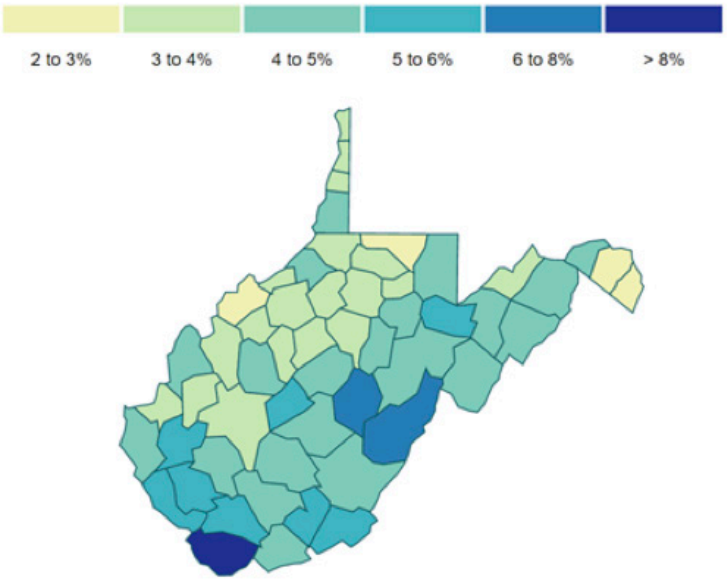
Increasing the cost of electricity in West Virginia would harm the state's economy in two primary ways. One, it would reduce the amount of household income available to families to spend on goods and services, therefore reducing demand in other sectors of the economy. For example, the extra money a family spends on electricity may mean fewer meals at local restaurants or delayed repairs to a home or automobile.

Two, it would increase the costs of healthcare, education, food, and durable goods, because electricity is the invisible ingredient in everything.

FIGURE 6

Average Energy Burden as Percent of Income

Federal data show West Virginia households living in several counties already pay between 6 and 8 percent of their income for energy bills.



SOURCE: U.S. DEPARTMENT OF ENERGY

Rising electricity costs force businesses to raise the prices of the goods and services they offer.

High electricity costs also jeopardize jobs in energy-intensive industries like manufacturing and mining, which compete in a global marketplace. Increasing electricity costs leave them at a competitive disadvantage.

Manufacturing

Industries like manufacturing use large quantities of electricity, making them vulnerable to rising prices. This is of particular concern in West Virginia, where 43.6 percent of the electricity consumed in the state was used for industrial purposes in 2019.[29]

Increasing electricity prices could jeopardize West Virginia's nearly $7.5 billion manufacturing industry—which accounted for approximately 9.6 percent of the state's gross domestic product in 2019—by making the state less competitive with companies in other states or countries.[30]

According to the Bureau of Economic Analysis (BEA), manufacturing employs more than 49,400 West Virginians with average annual wages of nearly $57,800, providing a high standard of living for West Virginia workers.[31,32]

Mining

Coal production and employment in West Virginia have declined dramatically since 2011, when the state produced 134 million short tons and employed 23,307 miners, according to EIA data (See Figure 7).[33,34] Production has declined due to competition with low-cost natural gas and Obama-era regulations designed to reduce coal consumption.

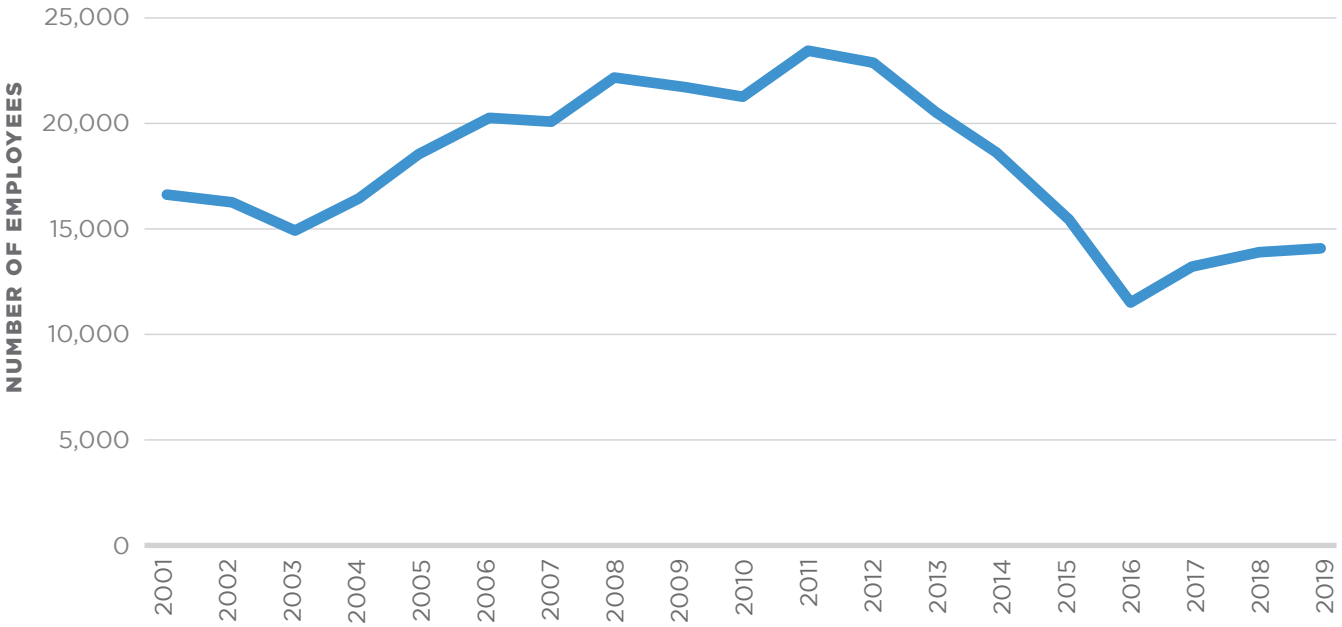
Despite declining production, coal mining is still a vital part of the West Virginia economy, constituting 6.5 percent of the state's gross domestic product in 2019.[35]

EIA data show West Virginia was the sec-

FIGURE 7

Aggregate Coal Mine Average Employees, Annual

West Virginia coal mining jobs peaked in 2011 at more than 23,300 jobs. Jobs rebounded slightly from their 2016 low in 2017, 2018, and 2019.



SOURCE: U.S. ENERGY INFORMATION ADMINISTRATION

ond-largest coal-producing state in the nation, producing more than 92 million short tons of fuel in 2019.[36] West Virginia's coal mining industry employed nearly 14,000 people, and BEA data show West Virginia miners earned average wages of about $104,000 in 2019.[37,38]

The Renewable and UNG scenarios represent the largest threat to this sector of the economy because they would replace the electricity generated by coal. The CCS scenario, however, could represent an opportunity to grow coal-mining jobs in the state because the parasitic load imposed on the existing coal plants with CCS technology would require electricity providers to burn more coal to produce the same amount of electricity for sale to West Virginia customers.

Oil and Natural Gas

Rising natural gas consumption in the UNG scenario, and to a much lesser extent in the Renewable scenario, would likely result in lost coal mining jobs, but they could lead to an increase in jobs in the natural gas sector in West Virginia.

Natural gas production has increased substantially in West Virginia thanks to hydraulic fracturing, also known as "fracking." West Virginia is the 5th largest natural gas-producing state in the country, accounting for 7.1 percent of U.S. production in 2020.[39]

BEA data show there were 7,400 West Virginians employed in the oil and gas sector in 2019.[40]

While energy-intensive industries would be impacted most, all industries would be affected by higher electricity prices under the CEPP. For example, rising electricity prices would mean school districts would have less money to hire and retain teachers, which could lead to layoffs or raising taxes to fund education. ■

Section V: Emissions Reductions

The stated goal of the CEPP is to reduce carbon-dioxide emissions from the electricity sector. Figure 8 shows the effect of the CEPP in West Virginia under each of the three scenarios studied.

Emissions would fall the most in the Renewable scenario, followed by the CCS scenario and the UNG scenario. While emissions decrease the most in the Renewable scenario, these emissions reductions cost more than the reductions achieved in the other scenarios.

Figure 9 shows the cost of reducing a ton of carbon dioxide in each scenario in the year 2031. The cost of reducing emissions is lowest in the CCS scenario, followed by the UNG scenario, with the Renewable scenario being the most expensive.

The cost of reducing carbon-dioxide emissions in the renewable scenario exceeds the Social Cost of Carbon estimates for 2030 established by both the Obama and Trump administrations (See Figure 9). The cost of reducing carbon-dioxide emissions in the CCS and UNG scenarios exceeds the Social Cost of Carbon estimates for 2030 established by the Trump administration, but both come in under Obama administration estimates.

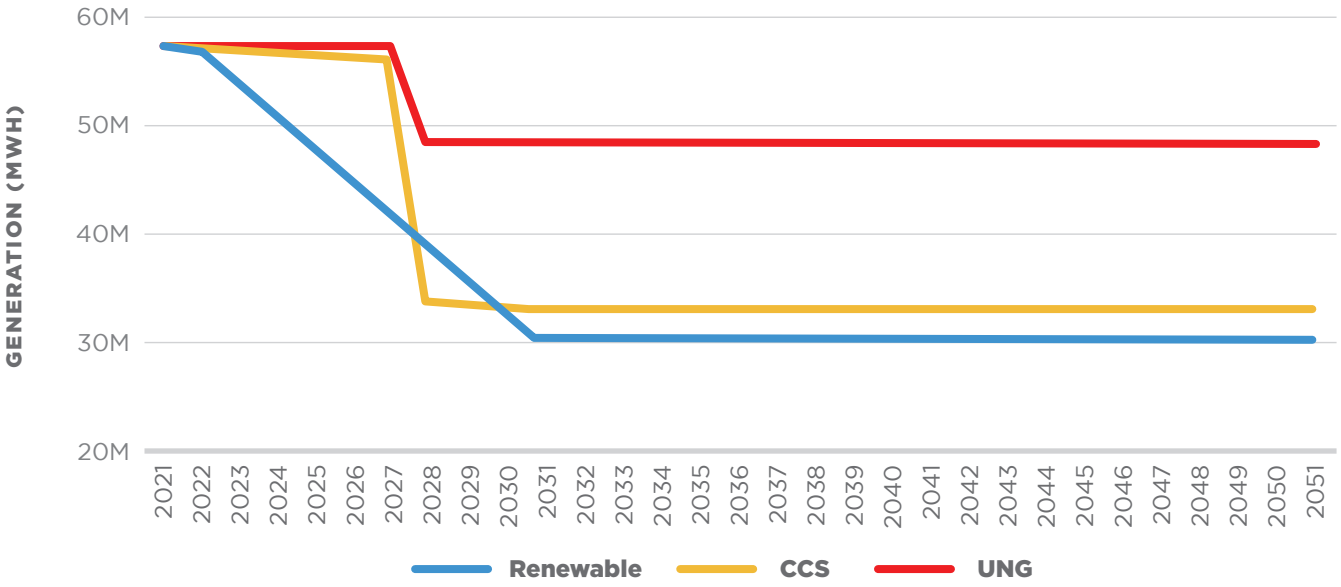
These conclusions have important ramifications for energy policy because they show that using wind and solar to meet CEPP requirements costs more than the damages associated with additional carbon-dioxide emissions under the Obama administration's own cost estimates. This means it is better to do nothing than to implement the Renewable scenario.

However, carbon-dioxide reductions under the CCS and UNG scenarios cost less than the Obama SCC estimates, which means proponents of the CEPP should embrace these technologies if they are serious about reducing emissions in the most cost-effective way possible. ■

FIGURE 8

West Virginia Annual Carbon Dioxide Emissions

Emissions fall in all three scenarios, but they decrease the most in the Renewable scenario, closely followed by the CCS scenario.

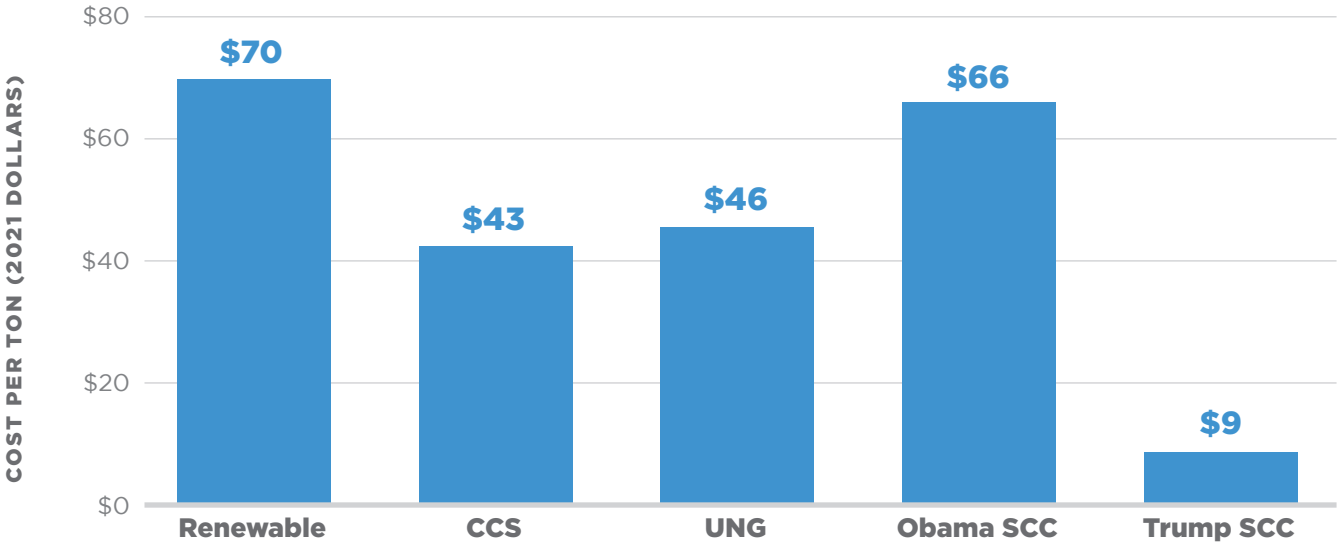


SOURCE: AMERICAN EXPERIMENT MODELING

FIGURE 9

Cost of Carbon Dioxide Emissions Reductions to 2031

The cost of reducing emissions under CEPP exceeds the estimated economic damages of each ton of carbon dioxide estimated by Obama and Trump Administrations.



SOURCE: AMERICAN EXPERIMENT MODELING

Conclusion

Many residents across the Mountain State already struggle to make ends meet with 16 percent of the population currently living in poverty. Compliance with the CEPP in West Virginia would only make this problem worse by increasing the cost of electricity by an average of $1,100 per electricity customer through 2052. Even if CCS or natural gas were allowed to qualify for the CEPP requirements, West Virginia electricity customers would still see large increases in their electric bills.

Costs are driven by a massive buildout of solar panels, wind turbines, and transmission lines, in addition to the costs associated with higher property taxes, utility profits, and the cost of building new natural gas plants to provide power when the sun is not shining, or the wind is not blowing.

While proponents claim the CEPP is needed to reduce carbon-dioxide emissions, the costs of implementing the plan dramatically outweigh the benefits.

However, for many in Appalachia, proposals like the CEPP come as no surprise. The politicized nature of energy policy has led proponents of wind and solar to lead a charge against coal and natural gas. This phenomenon was perfectly encapsulated by Presidential candidate Hillary Clinton when she stated, "We're going to put a lot of coal miners and coal companies out of business" in a 2016 Democratic Town Hall.[41] What Clinton forgot to mention is how those communities would be affected by this government-imposed destruction of their way of life.

These ill-conceived policies have turned once-affluent, resource rich areas of West Virginia into areas with high levels of poverty and substance abuse. Sadly, seven out of ten individuals battle addiction, and nearly everyone in West Virginia has been affected by this unfortunate epidemic in some way.[42,43] As communities that once depended on jobs in the natural resources industry were continuously stripped of economic opportunities by the federal government, they struggled to remain hopeful for the future of the state.

This is a key reason why 2020 Census Bureau data show West Virginia experienced the most significant population decline in the country, losing 60,000 residents in the last ten years.[44] The CEPP would have continued to destroy the West Virginia way of life and imposed far more harm to West Virginia families and the state's economy than the carbon-dioxide emissions it aimed to reduce. ■

Appendix

Use of State-Level Analysis

While the CEPP is a de facto renewable energy mandate for electricity providers nationwide, this analysis calculates the cost of each state increasing its share of "clean" energy by 4 percent each year. It does not capture interstate flows of electricity or quantify the costs incurred by individual utilities that may operate or own generation assets in other states.

Annual Average Additional Cost Per Customer

The annual average additional cost per customer was calculated by dividing the average annual cost of CEPP compliance by the number of electricity customers in West Virginia.[45] This methodology is used because rising electricity prices increase the costs of all goods and services. Businesses will attempt to pass these additional costs on to consumers, effectively increasing the cost of everything. Therefore, this method helps convey the total cost of the CEPP for West Virginia households in a way that is more representative than calculating the costs associated with higher residential electric bills.

Time Horizon Studied

This analysis studies the impact of the CEPP on electricity prices from 2021 to 2052. This time horizon was selected for two reasons.

One, power plants are large investments, like houses. Like a mortgage, electricity customers pay off the cost of the plant each year, meaning decisions made today will affect the cost of electricity for decades to come. Electricity prices would increase much more in the early years if the study did not allow for the gradual repayment of the solar panels, wind turbines, and transmission lines needed to comply with the CEPP.

Two, the study sought to show the cost of hitting the targets established by the CEPP and maintaining the amount of carbon-dioxide-free power on the electric grid into the future to prevent emissions from rising after the program expires in the early 2030s.

This assumption is very conservative because the CEPP seeks to achieve a grid that is, on average, only 80 percent carbon-free. The Biden administration has stated its desire to make the electricity sector 100 percent carbon-free by 2035, which would be exponentially more expensive based on today's technologies.[46],[47]

CCS Assumptions

This study makes a number of assumptions about CCS technology. Capital costs for CCS retrofits in West Virginia are assumed to be $1.4 million per MW, based on the projected cost estimates of $1 billion to retrofit the 705 MW Milton R. Young coal-fired power plant in North Dakota.[48] CCS equipment is estimated to become operational in 2028, which is generally consistent with the projected implementation timeline for the Milton R. Young station.

Additionally, this study did not evaluate the geologic plausibility of using CCS technology in West Virginia.

Electricity Generation Assumptions

Electricity generation is kept constant at 2019 levels throughout the course of this model run. This assumption is made for two reasons. One, load-growth projections are subject to a wide variety of assumptions, such as energy efficiency measures that reduce electricity demand. Furthermore, electric vehicle adoption and the electrification of other sectors of the economy are difficult to accurately predict.

Two, this analysis is intended to show the difference in cost between operating the electric system in West Virginia today compared to what it would cost to generate the same number of MWhs of electricity under the CEPP.

Natural Gas Capacity in the Renewable Scenario

Our model does not allow for load modification. Instead, natural gas capacity is maintained to provide enough firm, dispatchable capacity in the Renewable scenario at all times. This is consistent with the methodology used by the Analysis Group in its assessment of a Clean Energy Payment Program, which was one of the first analyses released supporting the CEPP.[49]

Transmission

Distance per mile costs were estimated from the 2021 Midcontinent Independent Systems Operator Transmission Cost Estimation Guide.[50] This analysis uses the MISO-wide average cost estimates of double circuit 115kv lines for any lines less than 230kv, and the MISO-wide average cost estimates for double circuit 345kv for any lines above 230kv.

Utility Returns

The amount of profit a utility makes on capital assets is called the Rate of Return (RoR) on the Rate Base. For the purposes of our study, the capital structure used is that of Appalachian Power Company (APCo): 49.84 percent debt and 50.16 percent equity, and a return on debt of 4.78 percent and return on equity of 9.75 percent.[51]

Property Taxes

Property tax payments for utilities were calculated to be 2 percent of the undepreciated cost of generation assets installed in each respective scenario, based on West Virginia property tax rate classes.[52]

Unit Lifespans

Different power plant types have different useful lifespans. According to the National Renewable Energy Laboratory (NREL), wind turbines have a useful life of 20 years, and solar panels have a useful life of 25 to 40 years.[53] Our analysis uses a 25-year lifespan for solar because this is the typical warranty period for solar panels. Wind and solar facilities are rebuilt, or "repowered," in our model after reaching the end of their useful lifespans.

Natural gas facilities are estimated to have a useful life of 60 years, and coal facilities with CCS technology were estimated to have a useful remaining life of 30 years, but this could potentially be extended with proper upgrades and maintenance.

Solar Panel Degradation

Recent research has found that solar panels are degrading faster than previously anticipated.[54] This research found the degradation rate for utility-scale solar is 0.8 percent per year. Our study does not take this degradation into account.

Wind Turbine Degradation

Academic research from Lawrence Berkeley National Labs has found wind turbine performance declines smoothly with age until there is a large step-down in production after ten years.[55] This analysis does not incorporate declines in wind turbine performance.

Curtailment

Future curtailment values in the Renewable scenario will depend largely on transmission buildout. Annual curtailment levels for this model were estimated using NREL curtailment values, the highest percentage for any year being 6 percent.[56]

Capacity Factors

Initial annual capacity factors used for West Virginia energy sources in 2021 are based on EIA's state electricity profile for West Virginia.[57] These are the best representation of annual capacity factors in the state.

Capacity factors for baseline levelized cost of energy (LCOE) values for existing power plants were obtained through FERC Form 1 data on power plants

owned by Appalachian Power Company, Monongahela Power Company, Virginia Electric & Power Company, Kentucky Power Company, and Wheeling Power Company. Federal Regulatory Commission (FERC) Form 1 data for capacity factors were used because they are the best representation of the cost per megawatt-hour (MWh) for energy sources in West Virginia. Annual capacity factors within the model are then used to calculate new LCOE values derived from the baseline LCOE values.

Capital Costs

Total Overnight Capital cost estimates for new capacity for each generation technology are taken from Region 11 PJMW of the EIA's Electricity Market Module, Assumptions for the Annual Energy Outlook 2021.[58] National estimates are used for Variable Operations & Maintenance (O&M), Fixed O&M, and heat rates. These capital and operating costs are held constant throughout the model run.

Fuel Cost Assumptions

Fuel costs for existing natural gas and coal facilities were estimated using FERC Form 1 data for existing facilities. Fuel costs for new natural gas facilities were estimated using historical data provided by EIA's Electric Power Monthly.[59] All fuel costs were held constant throughout the model run.

Generation Costs for Existing Facilities

Generation costs for existing facilities were obtained using FERC Form 1 data. LCOE values were calculated for each energy source (coal, natural gas combined cycle, natural gas combustion turbine, nuclear, wind, solar, etc.) using costs and generation totals provided by FERC Form 1 data for Appalachian Power Company, Monongahela Power Company, Wheeling Power Company, Virginia Electric & Power Company, and Kentucky Power Company. These LCOE values are then used within the model and are based on the annual capacity factors of each energy source.

Generation Costs for New Generation Facilities

Generation costs are based on LCOE values for new and existing energy sources in the state of West Virginia during the duration of the model (2021-2052). Generation costs represent the additional generation costs incurred above present-day costs of operating the grid.

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