WEST VIRGINIA'S ENERGY FUTURE

RAMPING UP RENEWABLE ENERGY TO DECREASE COSTS, REDUCE RISKS, AND STRENGTHEN ECONOMIC OPPORTUNITIES FOR WEST VIRGINIA

WVULAW
Center for Energy and Sustainable Development

1 EXECUTIVE SUMMARY

At the end of this tumultuous and historic year, West Virginia's electric utilities will publish plans showing the resources they intend to use to generate electricity for West Virginians over at least the next decade.

In anticipation of those plans, this report regarding West Virginia's Energy Future shares the following findings based on almost a year of research, economic modeling, debate, and expert feedback:

- **For at least five reasons, our electric utilities urgently need to consider a major ramping up of renewable energy and energy efficiency that begins today.**

  These five reasons provide the backdrop for why we need to consider a major ramping up of renewable energy and energy efficiency:

  1. Renewable energy is now cheap, and it's continuing to get cheaper.
  2. Customers — both businesses and individuals — overwhelmingly are demanding renewable energy.
  3. Diversifying our power resource mix is critical to competing in the growing regional renewable energy economy and, more broadly, securing a place in the 21st century energy economy.
  4. The financial risk posed by emissions from power plants is growing due to majority public support for bipartisan proposals to address climate change by charging fees for carbon dioxide emissions. These fees would necessarily hit coal-fired power plants hardest because those plants emit the most carbon dioxide.
  5. Major lenders and investors increasingly are withholding capital from utilities that aren't transitioning away from emission-heavy resource mixes.

- **A major ramping up of renewable energy and energy efficiency in West Virginia over the next fifteen years would be cost-competitive versus our current trajectory of continued dependence on coal — while also delivering important additional benefits.**

  Specifically, diversifying our electric resource mix through a major ramping up of renewable energy and energy efficiency:

  1. Is cost-competitive versus our current trajectory of continued dependence on coal — either ≤ 5% cheaper or ≤ 5% more expensive depending on whether a modest carbon dioxide emissions fee is charged (as is currently anticipated in the planning of most electric utilities).
  2. Creates thousands of renewable energy and energy efficiency jobs, presents a net-positive impact on overall employment in the state through 2030, and has an almost neutral (-0.0002%) net-impact on overall employment through 2035.
  3. Would diversify our economy, reduce our exposure to downswings in the coal industry, and enable us to join the growing regional renewable energy economy.
  4. Would leave the door open for innovation in the coal industry to address emissions liabilities and regain competitiveness.
  5. Creates no new liabilities for emissions and reduces our financial exposure to fuel costs.
  6. Avoids billions of dollars' worth of adverse health impacts.

- **West Virginia's ramping up of renewable energy and energy efficiency should be complemented with a federal reinvestment in miners, coal communities, and our new energy economy.**

  As Congress considers bipartisan proposals to charge for carbon dioxide emissions, our congressional leaders should consider withholding their support unless the legislation is paired with a federal reinvestment in West Virginia to honor the contributions of our coal communities and secure West Virginia's role in the new energy economy. Doing so can ensure that ramping up renewable energy and energy efficiency in West Virginia is beneficial for all West Virginians and creates positive employment effects not only through 2030 but also beyond.

- **We can make the ramping up of renewable energy and energy efficiency in West Virginia work for everyone, including customers, current power plant workers and their communities, and our electric utilities.**

  The ramping up of renewable energy and energy efficiency in West Virginia can and should be pursued in a way that works for our utilities, their employees and communities, and customers. West Virginia can benefit from the example of other states like New Mexico that are demonstrating how low-cost debt can be used to replace legacy fossil fuel power plants with new renewable energy facilities – all while listening to communities and delivering jobs and other economic benefits.

The West Virginia Legislature already took an important step in this direction in 2020 when the House of Delegates unanimously passed Coal Transition Plan legislation. This legislation would mandate worker and community input in a planning process coordinated by the W.V. Department of Commerce to anticipate and strategically respond to economic dislocations caused by coal's declining competitiveness. If this unanimous bipartisan legislation is also approved by the Senate and Governor, it will bring increased resources and coordination to efforts to make the energy transition work for all West Virginians.

Especially when presented in this summary form, our findings could be perceived as suggesting that diversifying the electric resource mix in West Virginia by ramping up renewable energy and efficiency will be easy. That certainly is not the case.

The transition described in our report can only be implemented in a favorable way if it is carried out with deliberate planning and care for everyone involved (as contemplated in the Coal Transition Plan legislation passed by the House of Delegates). Notwithstanding the challenge involved, it is a process that we should embark on urgently and with determination. Avoiding this discussion will not temper the broader economic and financial forces that are transforming the energy industry around us. Therefore, we should confront this challenge head on and begin a new of chapter of West Virginian energy leadership with the grit and perseverance that Mountaineers have demonstrated for centuries.

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ACKNOWLEDGEMENTS

The following organizations provided invaluable support and technical assistance in making this report possible:

West Virginia University College of Law, Center for Energy & Sustainable Development

Downstream Strategies

Synapse Energy Economics

GridLab

WVU LAW
Center for Energy and Sustainable Development

The Center for Energy and Sustainable Development is an energy and environmental public policy and research organization at the West Virginia University College of Law. The Center focuses on strengthening opportunities for West Virginia and its residents in the context of nationwide trends to reduce carbon emissions and pursue sustainable energy policies.

GridLAB

GridLab is an innovative non-profit that provides technical grid expertise to enhance policy decision-making and to ensure a rapid transition to a reliable, cost effective, and low carbon future.

Synapse
Energy Economics, Inc.

Synapse Energy Economics is a small, independent research and consulting firm specializing in energy, economic, and environmental topics. Since its inception in 1996, Synapse has grown to become a leader in providing rigorous analysis of the electric power sector for public interest and governmental clients. Synapse's expertise includes environmental economics, resource planning, electricity dispatch and economic modeling, energy efficiency, renewable energy, energy storage, transportation and building sector electrification, transmission and distribution, rate design and cost allocation, risk management, benefit-cost analysis, environmental compliance, climate science, and both regulated and competitive electricity and natural gas markets.

Downstream Strategies
Ideas that sustain.

Downstream Strategies is an environmental and economic development consulting firm located in West Virginia. We are considered the go-to source for objective, data-based analyses, plans, and actions that strengthen economies, sustain healthy environments, and build resilient communities.

2 BACKGROUND | 5 REASONS WHY WE NEED TO CONSIDER RAMPING UP RENEWABLE ENERGY BEGINNING TODAY

West Virginia's electric utilities will publicly propose plans at the end of this year that set forth the power generating resources the utilities intend to employ over the next decade.

There are at least five reasons why the utilities need to consider featuring in their plans a major ramping up of renewable energy and energy efficiency that begins today.

Any long-term plan that does not adequately account for these five considerations will risk unnecessary costs for West Virginia customers and missed economic opportunities for West Virginia workers and businesses.

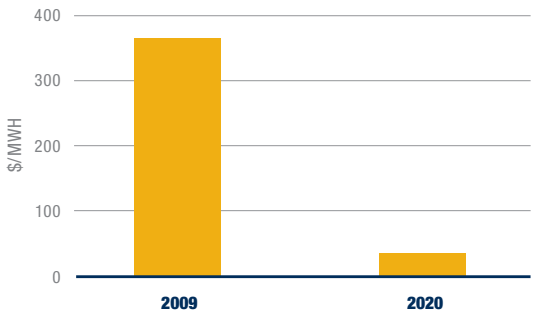
REASON NO. 1 RENEWABLE ENERGY IS NOW CHEAP, AND IT'S GETTING CHEAPER

Renewable energy cost declines have been dramatic over the past decade, and the decreases continue to exceed forecasts.

Since 2009, **the cost of solar energy and wind energy have decreased by 90 percent and 71 percent respectively**.[1] Specifically, solar energy has gone from $359 per megawatt-hour to $37 per megawatt-hour.[2] These figures do not even include any applicable tax incentives or rebates.[3]

1 Lazard, *Levelized Cost of Energy Analysis Ver. 14.0* 9 (2020).
2 *Id.* at 8.
3 *Id.*

UNSUBSIDIZED LEVELIZED COST OF ENERGY FOR SOLAR

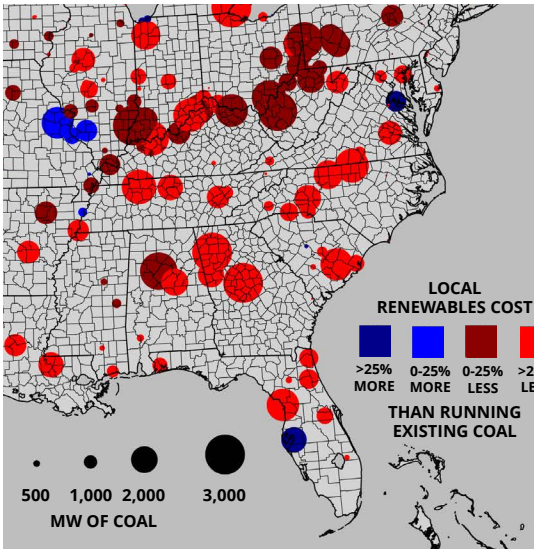


As a result of these dramatic cost declines, new renewable energy projects frequently are not only cheaper than new fossil fuel power plants, **often a new renewable energy project is cheaper to install and operate than the ongoing cost to operate and fuel an existing coal-fired power plant.**

In an October 2020 analysis, the financial advisory firm Lazard estimated that the ongoing cost of a new solar energy project (including after incorporating the initial construction costs) is $24 to $32 per megawatt-hour, whereas the ongoing cost just to operate an existing coal-fired power plant is $34 to $48 per megawatt-hour.[4] In other words, building and operating a new renewable energy facility will often be cheaper than keeping an existing coal-fired power plant running. The decision to replace a coal-fired power plant with renewable energy is therefore similar to deciding to buy a new refrigerator because the upfront cost can quickly be recouped through immediate energy savings.

Due to the increasing frequency with which new renewable energy projects have been shown to be cheaper than existing coal-fired power plants, a recent analysis determined that, as of 2018, 74 percent of U.S. coal capacity could be replaced by nearby renewable energy generation with immediate cost savings, whereas in 2025 that percentage will increase to 86 percent.[5] As shown in the adjacent map, the coal facilities that will be more expensive than local renewable energy in 2025 include every single coal power plant in West Virginia. Other recent analyses have confirmed that certain West Virginia coal-fired power plants have already been losing millions of dollars over the past three years and are likely to continue losing money into the future.[6]

Given the speed with which coal-fired power plants are becoming uneconomical versus renewable energy power plants, West Virginia's electric utilities urgently need to consider diversifying their resource portfolios to include more renewable energy facilities.



SOURCE | Energy Innovation Policy & Technology, Vibrant Clean Energy, *Cost of Operating Existing Coal-Fired Power Plants Compared with Building New Wind or Solar within 35 Miles (2025).*

4 *Id.* at 6. These figures are reflective of current tax policies, including the investment tax credit and the production tax credit.

5 E. Gimon *et al, Coal Cost Crossover: Economic Viability of Existing Coal Compared to New Local Wind and Solar* 1-2 (Mar. 2019).

6 *Testimony of R. Wilson on Behalf of the Sierra Club, Application of Appalachian Power Co. for a 2020 Triennial Review of Rates*, Case No. PUR-2020-00015 (Va. Corp. Comm'n July 30, 2020).

REASON NO. 2 CUSTOMERS ARE DEMANDING RENEWABLE ENERGY

The rapid decline in renewable energy costs is part of why customers – businesses and individuals — are demanding renewable energy.

Another reason is cost certainty. While no one knows what coal or natural gas fuel prices will be in 2030, we do know that sunshine and wind will continue to be free.

Regardless of the reason, we know that businesses and individuals are demanding renewable energy.

BUSINESS DEMAND FOR RENEWABLE ENERGY

Because of the magnitude of their energy needs (and the corresponding bargaining power that comes with it), businesses in particular have emerged as major drivers of demand for renewable energy.

A prominent example of the strong demand from businesses for renewable energy is the RE100 Initiative. The RE100 Initiative represents over 250 major companies, including businesses like Anheuser-Busch, General Motors, Kellogg's, Trane, and PNC, that have committed to procure 100 percent renewable electricity.[7] Of particular importance to West Virginia from the RE100 group due to their local employment impacts are Walmart, Procter & Gamble, Target, and General Mills. Looking beyond the RE100 initiative, other major employers in West Virginia with significant renewable energy procurement efforts include Amazon, AT&T, Home Depot, Lowe's, PepsiCo, Toyota, and UPS.

As our state's economic development officials have explained, building renewable energy projects in West Virginia is critical to attracting and retaining major employers. In February, our Commerce Secretary Ed Gaunch relayed to state legislators that when a company is considering an investment in West Virginia "[i]nvariably . . . the first or second question in terms of criteria [will be]: Where does your state stand in terms of renewable energy?"[8] Because of the current lack of renewable energy in West Virginia, "[f]rankly, we don't ever make the cut," Secretary Gaunch explained.[9] This unfortunate situation was reiterated to our legislators by Mike Graney, Executive Director of the West Virginia Development Office, who said: "Not having, frankly, the solar box checked is a problem, and we've heard that from a lot of different companies."[10]

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7 For a complete list of RE100 companies, see https://www.theRE100.org/companies.
8 B. Patterson, *Sparks Fly in W.Va. Legislative Energy Committees Over Utility Solar Bill*, W.V. Pub. Broadcasting (Feb. 4, 2020).
9 *Id.*
10 P. Kabler, *Solar energy bill advances in Senate, with pro-coal provision added*, Charleston Gazette-Mail (Feb. 13, 2020).

WIDESPREAD DEMAND FOR RENEWABLE ENERGY

While major employers sometimes represent the loudest voice demanding renewable energy, they certainly are not alone. In an opinion poll performed on behalf of the electric utilities' national trade association, 74 percent of customers said that utilities should use solar energy "as much as possible," and 70 percent of customers agreed that "[i]n the near future, we should produce 100% of our electricity from renewable energy sources."[11]

Utilities have recognized this widespread demand for renewable energy from their customers, including American Electric Power — the parent company of Appalachian Power and Wheeling Power — which has stated, "What we have learned is that a strong majority of customers, especially large commercial and industrial customers, want clean energy."[12]

Acting on this demand from customers for renewable energy, West Virginia's electric utilities must quickly begin assessing how to make more renewable energy available to their customers.[13]

REASON NO. 3 THE NEED TO STRENGTHEN ECONOMIC COMPETITIVENESS THROUGH ENERGY DIVERSIFICATION

Diversifying our energy resource mix by ramping up renewable energy is not just a matter of cost savings and satisfying customer preferences, it is critical to the future economic competitiveness of West Virginia.

While our coal legacy is a point of pride for many West Virginians, our ongoing dependence on coal has left us dangerously vulnerable to swings in the coal industry. Moreover, our neighboring states are charging forward with growing a renewable energy economy. For us to meaningfully participate and compete in that thriving renewable energy economy in the region – and the 21st century energy economy more broadly — we need to begin a significant buildout of renewable energy in West Virginia.

11 D. Roberts, *The public wants 100% renewable energy, and quick*, Vox (Oct. 11, 2018).

12 Am. Elec. Power, *Renewables: Meeting Customer Demands*, https://www.aepsustainability.com/energy/renewables/.

13 Implementation of the bipartisan solar legislation that was enacted in West Virginia in 2020, S.B. 583, is an important first step in that direction. *See* W. Va. Code Ann. §§ 24-2-1o. *et seq.*

THE ECONOMIC DANGERS OF CONTINUED DEPENDENCE ON COAL

As identified recently in *West Virginia Economic Outlook: 2020-2024* published by the West Virginia University Chambers College of Business and Economics, the coal downturn that occurred from 2012 through 2016 led to West Virginia "cities and counties not only experienc[ing] steep losses in severance taxes as coal production fell sharply . . . but also struggl[ing] with drops in B&O, property tax, local sales and other types of revenue as several major mining companies and all their affiliate companies entered bankruptcy or were severely financially impaired enough not to pay taxes and other liabilities."[14] Those "losses filtered down the supply chain to manufacturers, wholesalers and other companies that did business with mining companies" such that those businesses "experienced revenue losses of their own."[15] What's more, "[l]osses in population only exacerbated problems for many areas, as local school systems saw funding declines."[16] According to the same report, public finances also suffered at the state level during this period, "with much of the revenue drop-off tied to eroding coal and natural gas severance tax collections."[17]

Notwithstanding a minor rebound in coal production in southern West Virginia in 2017 and 2018,[18] *West Virginia Economic Outlook 2020-2024* forecasts declines in coal production and employment of 2.3 and 1.7 percent, respectively, on an annual basis from 2020 through 2024.[19] During this period, coal mining operations in southern West Virginia are expected to "face significant pressure," and coal operations in northern West Virginia will face "appreciable downside risks."[20]

One can only expect that the forecasted decreases in coal production and employment will yet again result in the corresponding problems they have caused in the past: government revenue declines, population loss, cuts to education budgets, and negative effects on related businesses. To reduce our vulnerability to downswings in the coal economy, it is critical that West Virginia's electric utilities contribute to the diversification of our energy sector by considering a ramping up of renewable energy and energy efficiency.

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14 B. Lego *et al, W. Va. Econ. Outlook*: 2020-2024 15, W. Va. Univ. (Fall 2019).
15 *Id.*
16 *Id.*
17 *Id.* at 15-16.
18 *Id.* at 30, Fig. 3.3.
19 *Id.* at 21.
20 *Id.*

COMPETING IN THE GROWING REGIONAL RENEWABLE ENERGY ECONOMY

Today, our neighboring states are already charging ahead with building renewable energy economies — with examples including Maryland's commitment to generate 50 percent of its electricity from renewable sources by 2030 and Virginia's commitment to generate 100 percent of its electricity from emission-free sources by 2050. Our neighbors are embarking on this endeavor not only to improve public health by reducing emissions — but also to ensure a strong economic position deep into the 21st century.

Before the COVID-19 crisis, the clean energy industry employed over 3 million Americans — as many as three times the number of Americans working in the fossil fuel sector.[21] Growth in the sector has swelled over the past five years, bolstered by expanding employment opportunities in energy efficiency, renewable energy construction and operations, clean vehicles, and expanding and upgrading the electric grid.[22] Importantly, the sector is broad in terms of trade skill and level of expertise, encompassing everything from traditional construction and maintenance, to electricians, technicians, engineers, and more.[23] Looking forward at likely energy industry employment trends, the U.S. Department of Energy predicts that renewable energy will constitute the largest source of electricity in the United States by 2050 (even without any federal or state policy changes) due to "declining costs of solar and wind renewable capacity."[24] Our neighboring states are reacting to these economic realities and acting to ensure their place in a changing energy sector.

At present, West Virginia is enabling the buildout of a renewable energy economy in neighboring states without securing a future in that economy for ourselves. Virginia, for example, has committed to shutting down all of its in-state coal-fired power plants by the end of 2024.[25] While Virginia builds out its renewable energy economy over the next decade, coal plants in West Virginia will likely continue to provide power to the grid in Virginia during this transition period. Once Virginia has adequately built out its renewable energy economy, the coal-fired power plants in West Virginia likely will no longer be able to compete on price with the new renewable resources in Virginia.[26] In the meantime, no new jobs, economic activity, or property tax revenue will have been created in West Virginia from the buildout of renewable energy resources.

To compete with the flourishing renewable energy economies in our neighboring states and ensure our place in the 21st century energy economy, West Virginia must immediately begin planning how to catalyze our own renewable energy economy through the diversification of our electric utilities' portfolio mix.

Some will argue that we should just utilize coal as long as possible. But forecasts showing weakening coal economics into the foreseeable future demonstrate that this would be a recipe for a costly, slow decline — all while missing out on the opportunity to build a 21st century renewable energy economy in West Virginia.

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21 E2, *Clean Jobs America 2020: Repowering America's Economy in the Wake of COVID-19* 2 (April 2020).

22 *Id.* at 8.

23 While substantial work remains to improve the quality, wages, and unionization rates of clean energy employment, appropriate policy measures can help ensure these jobs are just as rewarding as existing fossil fuel ones.

24 U.S. Energy Information. Admin., *Annual Energy Outlook 2020: Electricity* (Jan. 2020).

25 Va. Code Ann. § 56-585.5.B.1.

26 *See* E. Gimon *et al, Coal Cost Crossover: Economic Viability of Existing Coal Compared to New Local Wind and Solar* 1-2 (Mar. 2019); Energy Innovation Policy & Technology, Vibrant Clean Energy, *Cost of Operating Existing Coal-Fired Power Plants Compared with Building New Wind or Solar within 35 Miles (2025)*.

REASON NO. 4 THE INCREASING FINANCIAL RISK FROM EMISSIONS

Today, calls for carbon dioxide emission fees are coming not only from environmental advocates. They are coming from prominent voices on each side of the political aisle as well as from major businesses that will be significantly impacted by emissions fees. The expanding chorus in favor of charging emissions fees is primarily in response to the consensus that (1) emissions are increasing global average temperatures, (2) the increase in global average temperatures threatens human health and global security, and (3) transitioning to a nearly emission-free electric power sector worldwide is necessary to avoid the most devastating impacts on humans and the economy.

Showing that this recognition of emission risks bridges across the political aisle, our Representative David McKinley (R-WV) recently wrote together with a Democratic colleague, Rep. Kurt Schrader (D-OR), that "[c]limate change is the greatest environmental and energy challenge of our time, and our government is failing to meet it."[27] Similarly, in a message titled "It's time to act on climate change," our Senator Joe Manchin (D-WV) in 2019 voiced together with his Republican counterpart on the Senate Energy & Natural Resources Committee, Sen. Lisa Murkowski (R-AK), that "[t]here is no question that climate change is real or that human activities are driving much of it."[28] These two energy leaders for their respective parties stated that they "are committed to putting forward bipartisan solutions to help address [it]."[29]

Probably the most prominent bipartisan proposal for a long-term response to emission risks is the "Carbon Dividends" plan, which would impose a fee on carbon dioxide emissions and issue all net proceeds from that fee to individual Americans.[30] Remarkably, this proposal for charging emissions fees received support from companies that have major emissions in their operations like ConocoPhillips, BP, Ford, General Motors, Walmart, and Procter & Gamble.[31] Support for the Carbon Dividends emissions fee plan, however, does not come only from major corporations. A national sample of registered voters in 2020 showed that 71 percent of voters want the federal government to take action to limit carbon dioxide emissions and 65 percent of voters specifically support charging a fee for carbon dioxide emissions and then returning the money back to individuals as a dividend.[32] Even among Republicans (who historically have been less supportive of federal action to reduce carbon dioxide emissions), this proposal enjoys two-to-one support, and among Republicans under 40 years of age, this support increases to three-to-one.[33]

Ultimately, we don't know when and how the federal government is going to address the risks posed by carbon dioxide emissions. We do know, however, that support for federal action to address climate change and reduce emissions is strong and growing on a bipartisan basis. We also know that most bipartisan national plans to reduce emissions include charging a fee for carbon dioxide emissions. Given this strong, bipartisan support for a national fee on emissions, prudency

27 Rep. D. McKinley and Rep. K. Schrader, *Innovation and regulation can curb climate change*, USA Today (Jan. 31, 2020).
28 Sen. J. Manchin and Sen. L. Murkowski, *It's time to act on climate change – responsibly*, Wash. Post (Mar. 8, 2019).
29 *Id.*
30 Climate Leadership Council, *Bipartisan Climate Roadmap* vi, 2 (April 2020).
31 *Id.* at iii-iv.
32 Morning Consult, *Key Findings on Climate Policy & Carbon Dividends Plan* (Feb. 2020).
33 *Id.*

requires that West Virginia's electric utilities closely examine the potential high cost of emissions and the opportunity to avoid those costs by diversifying our power resource mix. This is the approach that most electric utilities now take when making long-term resource planning decisions.[34]

REASON NO. 5 CAPITAL IS FLEEING FROM COAL-DEPENDENT ELECTRIC UTILITIES

Regardless of whether electric utilities will act to reduce their exposure to the financial risks posed by carbon dioxide emissions, their shareholders and capital providers certainly will act — specifically by taking their capital elsewhere.

Following years of analyzing the financial risks posed by emissions, 2020 has become a tipping point in which the most prominent financial institutions are all announcing policies to steer their capital away from coal-dependent businesses.

The highest profile move has come from BlackRock — the largest asset manager in the world – which publicly stated earlier this year that "we are on the edge of a fundamental reshaping of finance" and "sooner than most anticipate — there will be a significant reallocation of capital."[35] BlackRock has elaborated publicly, stating that, because coal is "becoming less and less economically viable," the firm "do[es] not believe that the long-term economic or investment rationale justifie[s] continued investment in this sector."[36] Specifically, BlackRock is "in the process of removing from [its] . . . portfolios companies that generate more than 25% of their revenues from thermal coal production."[37] Moreover, BlackRock has stated that it will "closely scrutinize . . . businesses that are heavily reliant on thermal coal as a cost input, in order to understand whether they are effectively transitioning away from this reliance."[38]

This close scrutiny from BlackRock is already landing squarely on electric utilities. In May of this year, BlackRock shared that it had contacted the chief executive officer of an electric utility portfolio company to raise concerns regarding certain coal projects and seek a rationale for the company's investments in coal energy.[39] As American Electric Power — the parent of Appalachian Power and Wheeling Power — has stated: "What they say matters" — elaborating that American Electric Power "can't provide the solutions that we provide if we don't have investors behind it. And so if [financial institutions] say they don't want to invest in companies that have 25% of their revenues coming from . . . carbon emission facilities such as coal that's something that needs to be taken to heart."[40]

Far from being a rogue actor among the financial community, BlackRock's new policies and actions represent the trend on Wall Street and beyond. Additional commitments from financial institutions to take capital away from coal-dependent companies include the following:[41]

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34 M. Ahluwalia, Center for Climate and Energy Solutions, *The Business of Pricing Carbon: How Companies Are Pricing Carbon to Mitigate Risks and Prepare for a Low-Carbon Future 15* (Sept. 2017) ("Sixty three percent of the companies in the utility sector . . . indicated they are using internal carbon pricing and 18 percent plan to do so by 2018.").

35 Larry Fink, *A Fundamental Reshaping of Finance (Letter to CEOs)* (2020).

36 Larry Fink, *Sustainability as BlackRock's New Standard for Investing* (Letter to Clients) (2020).

37 *Id.*

38 *Id.*

39 D. Stringer *et al, BlackRock Warns Korean Utility on Overseas Coal Plant Push*, Bloomberg Green (May 28, 2020).

40 D. Anderson, *American Electric Power's goal: 100% renewable energy?*, Energy and Policy Inst. (April 17, 2020).

41 J. Smyth, *Major banks announce new policies to help push utilities away from coal*, Energy and Policy Inst. (May 25, 2020); JPMorgan Chase & Co., JPMorgan Chase Adopts Paris-Aligned Financing Commitment (Oct. 6, 2020).

INSTITUTION	COMMITMENT
Barclays	"**[P]rohibit financing** to clients with more than **50% of their revenue** from thermal coal as of **2020**, transitioning to **30%** as of **2025**, and to **10%** as of **2030**"
BNP Paribas	"[T]arget to **end the use of coal** by its electricity-producing customers **by the end of 2030**"
Citi	Greenhouse gas reduction strategy will include **assessing** a "company's current efforts and future strategic plans designed to support its transition to a low-carbon energy future, including diversification options . . . to **shift away from coal-fired power sources**"
Goldman Sachs	"For financings involving any power sector companies that derive a significant portion of their generation from coal, we will engage . . . to understand their strategy to **diversify away from coal**"
JPMorgan Chase	As part of its commitment to align its financing with the goals of the Paris Agreement, "JPMorgan Chase will establish intermediate emission targets for 2030 for its financing portfolio" and "will focus on the oil and gas, electric power and automotive manufacturing sectors."
Morgan Stanley	"[W]ill engage with companies that derive a significant portion of their revenue from coal power generation to understand their strategy to **diversify away from coal**"

As providers of capital begin cutting off funding from companies that are dependent on coal, West Virginia's electric utilities urgently need to examine a diversification of their power resource portfolios that begins today. A failure to begin ramping up emission-free power projects could mean that we will no longer have access to the capital that is needed to build power plants and transmission lines in the future.

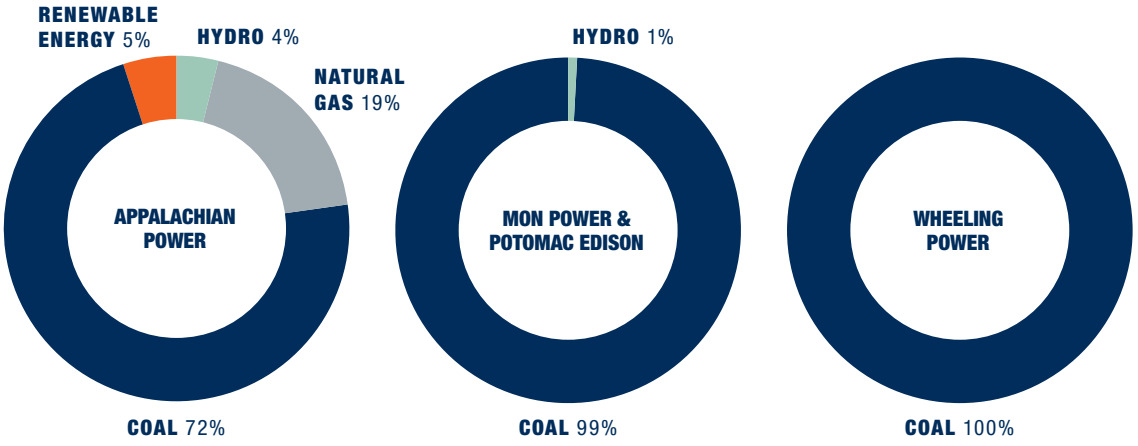
For each of the five reasons described above, our utilities need to consider featuring in their integrated resource plans a roadmap for ramping up renewable energy and energy efficiency that begins today. As described in the *Findings* section of our report, such a ramping up of renewable energy is not only cost-competitive but also presents many other benefits versus our current dependence on coal.

3 FINDINGS | RAMPING UP RENEWABLE ENERGY BEATS CONTINUED DEPENDENCE ON COAL

West Virginia's electric utilities are currently almost completely dependent upon coal.

Appalachian Power, Wheeling Power, and Monongahela Power ("Mon Power," which additionally provides the power supply for Potomac Edison's West Virginia territory) currently rely on coal-fired power plants to generate 72 percent, 100 percent, and 99 percent, respectively, of the electricity they produce for their customers.[42]

CURRENT ENERGY GENERATION BY WEST VIRGINIA'S ELECTRIC UTILITIES



42 Appalachian Power data from Appalachian Power Co., *Integrated Resource Plan* Ex. C, Sched. 2, Case No. PUR-2019-00058 (Va. Corp. Comm'n May 1, 2019). Mon Power data from U.S. Energy Info. Admin. 2018 Form EIA-923. Wheeling Power data based on Wheeling Power Co., *2016 Integrated Resource Plan* ES-2, Case No. 15-2004-E-P (W. Va. Pub. Serv. Comm'n Dec. 30, 2015).

An evenhanded analysis shows that diversifying the electric utilities' resource portfolios by ramping up renewable energy generation and energy efficiency is better for customers, for utilities, and for West Virginia's economy.

Specifically, ramping up renewable energy and energy efficiency:

- Is cost competitive;
- Creates thousands of renewable energy and energy efficiency jobs and a chance for policymakers to ensure economic opportunities for coal workers and their communities into the future;
- Diversifies the state's economy and puts us on competitive footing in the regional new energy economy;
- Leaves the door open for innovation in the coal economy;
- Reduces our exposure to financial risks posed by emissions liabilities and fuel cost variability; and
- Avoids $1.5 to $3.3 billion in regional healthcare costs that otherwise would be incurred.

Comparing Alternative Futures

To explore West Virginia's energy future, we modeled two alternative scenarios: (1) "**Continued Coal Dependence**," reflecting a continuation of our current trajectory,[43] and (2) "**Ramped Up Renewables**," reflecting a significant and deliberate diversification of our portfolio mix through the installation of renewable energy and energy efficiency.

In performing this modeling, we utilized software that has been employed by major electric utilities throughout the United States – including by Duke Energy, Xcel Energy, and Public Service Company of New Mexico (PNM) – and we used industry-accepted cost figures from the U.S. Department of Energy and its national laboratories, adjusted as needed for a West Virginia-specific analysis.[44]

Our objective was to see if a more diverse resource mix in West Virginia could decrease costs, reduce risks, and strengthen economic opportunities in the state.

43 To model the current trajectory, we conformed to the resource planning that has been publicly announced by the utilities, replicated historic generation patterns, and otherwise allowed the modeling software to choose additional least-cost resources as needed. For more details, see *Technical Appendix.*

44 For more details, see *Technical Appendix*.

CORE VALUES

In addition to presenting the results of our modeling, we believe it's important to identify and emphasize the core values that need to be central to any long-term energy plan for West Virginia.

Specifically, any long-term energy plan for our state must be:

RELIABLE

Paramount to any electric utility plan is the need to "keep the lights on."

To that end, our modeling software ensures the reliability of power resource portfolios by building adequate capacity to meet conservative utility reserve requirements and comply with grid operator rules.[45]

AFFORDABLE

An energy plan would be a non-starter if it is too expensive for a utility to implement or if it imposes unreasonable costs on customers.

In our modeling, therefore, we kept an eye not only on the total cost to our electric utilities but also on the impacts that the two scenarios would have on customer bills.

FORWARD-LOOKING

We designed the Ramped Up Renewables portfolio to avoid the potential high cost posed by continued reliance on an emissions-heavy resource mix.

It does not, however, put all of our eggs in one basket. By preserving some coal capacity, the Ramped Up Renewables plan keeps open the possibility of innovation within the coal industry to address emissions liabilities and become competitive again in the new energy economy.

VIABLE FOR UTILITIES

Our electric utilities are vital partners for keeping the lights on and powering our industries. No long-term energy plan would be effective if it does not work for them by allowing our utilities to recover their prudently incurred costs and operate successfully into the future.

For this reason, we have supplemented our overall focus on keeping costs down with a discussion of financing tools that can ensure a healthy future for our utilities. For more details, *see Supplemental Brief: We Can Make the Ramping up of Renewable Energy Work for Everyone.*

JOB-CREATING, EMPLOYEE-GUIDED, AND COMMUNITY-EMPOWERING

Job-Creating: We wouldn't support a long-term energy plan that doesn't have the potential to have a net-positive impact on jobs in West Virginia. That's why we included not only an analysis of the net employment impacts of our proposed scenario (which come out to -0.0002 percent through 2035) but also discuss the importance of pairing West Virginia's efforts with a federal reinvestment in the West Virginia energy economy. *See Supplemental Brief: West Virginia's Renewable Energy Ramp-up Should Be Complemented by a Federal Reinvestment in Miners, Coal Communities, and Our New Energy Economy.*

Employee-Guided: Net-positive job creation alone isn't enough. Any strategic shifts in our resource portfolio must be implemented in a way that is guided by employees and guarantees a role for all current power plant workers, as discussed in greater detail in *Supplemental Brief: We Can Make the Ramping up of Renewable Energy Work for Everyone.* This means worker engagement in the detailed planning to implement any strategic shift.

Community-Empowering: The same goes for any community that will be an integral part of this transition (e.g., communities that currently host power plants). There are now several examples of how communities like these can shape and benefit from the transition to renewable energy. Currently, for example, local and state leaders in New Mexico are receiving input from community members on how they desire to benefit from the replacement of the San Juan Generating Station.[46] Under New Mexico's Energy Transition Act of 2019, community input is being received on how to proceed with a financing and construction process to retire existing fossil fuel capacity and replace it with low-emission resources in a way that creates local benefits.[47] Through the Energy Transition Act, the state has set aside funds for community reinvestment and worker retraining, and community outreach and involvement is required as part of the energy transition process.[48] The currently proposed replacement of a portion of the San Juan Generating Station with renewable energy resources is estimated to bring 1,200 construction jobs to the surrounding area and $500 million to two local school districts.[49]

45 For more details, see *Technical Appendix*.
46 *See* San Juan County and City of Farmington, *San Juan Energy Transition Plan* (Dec. 20, 2019).
47 *See* N.M. Stat. Ann. § 62-18-1 et seq.
48 *Id*
49 C. Morehouse, *N.M. approves 100% renewables + storage replacement for San Juan coal capacity*, Utility Dive (July 30, 2020).

The Results

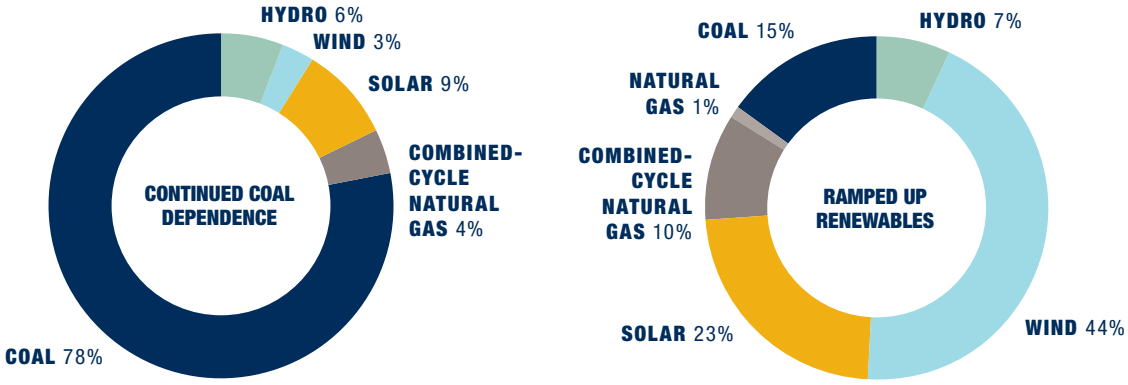
The Ramped Up Renewables scenario would result in affordable, diversified resource portfolios that are less vulnerable to emissions liabilities and fuel cost variability.

In the year 2035, instead of continuing to rely on coal-fired power plants to produce 78 percent of electric generation, Appalachian Power would generate 23 percent from solar, 44 percent from wind, 7 percent from hydropower, 11 percent from existing natural gas facilities, and 15 percent from existing coal facilities.

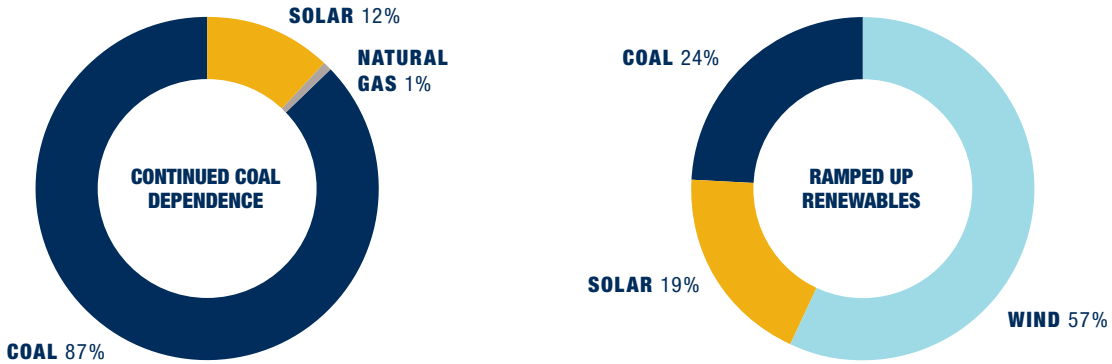
Similarly, in 2035, Wheeling Power would generate 57 percent of its electricity from wind, 19 percent from solar, and 24 percent from coal — instead of the business-as-usual scenario, which would result in continuing to depend on coal for 87 percent of generation.

Mon Power (which additionally supplies Potomac Edison's West Virginia territory with its power needs) would also arrive at more diversified generation in 2035, with specifically 37 percent from wind, 40 percent from solar, 10 percent from hydro, and 13 percent from coal. In contrast, the current trajectory would result in Mon Power continuing to depend on coal for 94 percent of electric generation in 2035.

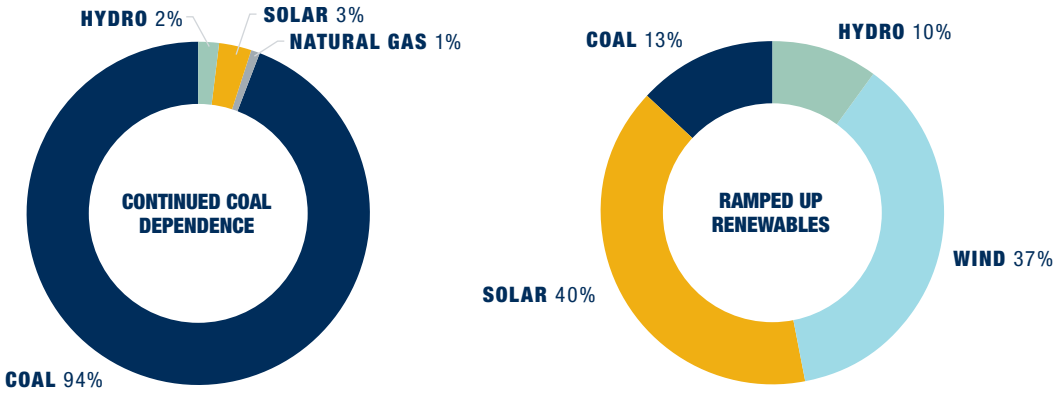
APPALACHIAN POWER: GENERATION IN 2035



WHEELING POWER: GENERATION IN 2035



MON POWER (INCLUDING POTOMAC EDISON): GENERATION IN 2035



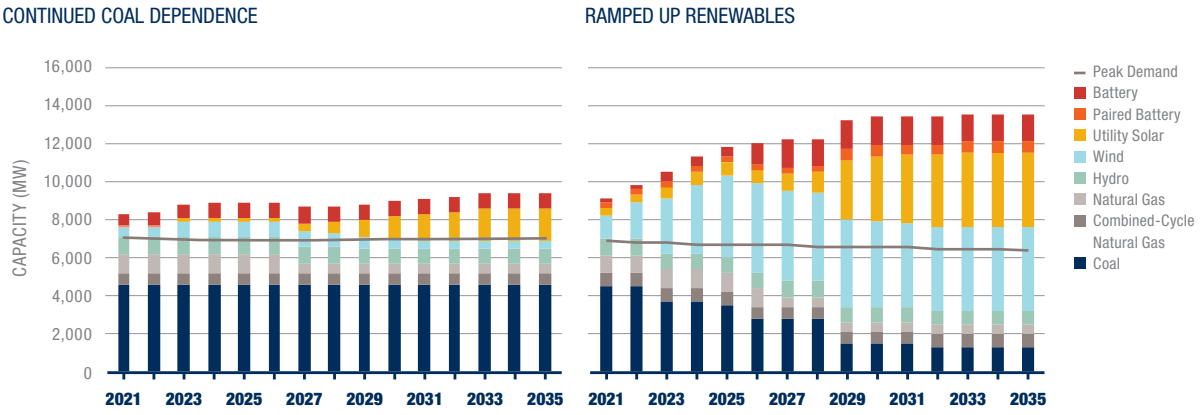
The Pathway

To arrive at these diversified generation portfolios in 2035, West Virginia's utilities would embark in a significant and deliberate ramping up of renewable energy and energy efficiency installations beginning in 2021, as described in greater detail below.

Appalachian Power

From 2021 through 2035, Appalachian Power would add 3,955 megawatts of solar, 3,684 megawatts of wind, and 2,022 megawatts of battery storage capacity. These renewable energy additions would be complemented by a ramping up of energy efficiency installations in Appalachian Power's service territory equal to 0.25 percent of the electric load in the territory in 2021 and increasing by 0.15 percent increments until leveling at energy efficiency installations equal to 2.0 percent of electric load per year in 2030.

APPALACHIAN POWER: PATHWAY TO 2035



Due to customers' power needs increasingly being met by renewable energy and energy efficiency, Appalachian Power would be able to gradually ramp down and, in 2028, ultimately retire the coal-fired John Amos Power Plant. As discussed above, we would only advocate

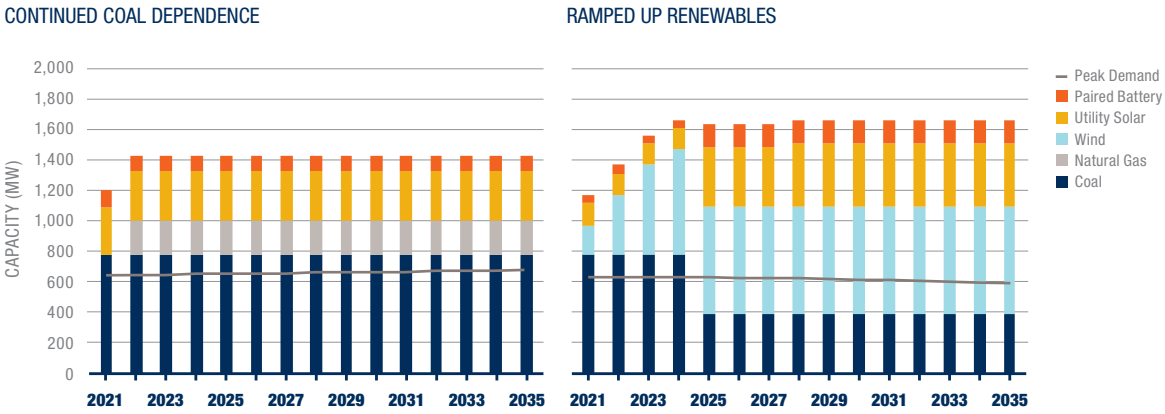
proceeding with such a major decision through an employee-guided and community-empowered process that ensures opportunities for employees at the John Amos Power Plant and the surrounding communities. Appalachian Power would additionally be able to retire its share in the coal-fired Clifty Creek Power Plant in Indiana in 2024 and in the coal-fired Kyger Creek Power Plant in Ohio in 2031.[50]

Lastly, Appalachian Power's Mountaineer Power Plant would be kept online. While the current business and scientific consensus is that the electric power sector needs to be emission-free (or close to it) by mid-century, keeping the Mountaineer Power Plant online for now will enable a more gradual transition for Appalachian Power's customers and its current coal-fired power plant workers (giving time for Appalachian Power and policymakers to ensure that new opportunities and benefits are created for those workers and their communities). Keeping the Mountaineer Power Plant online also leaves the door open for innovation within the coal industry to address emissions liabilities and become competitive again in the new energy economy.

Wheeling Power

Under our proposed Ramped Up Renewables scenario, Wheeling Power would engage in a similar deployment of energy efficiency and renewable energy as Appalachian Power through 2035.

WHEELING POWER: PATHWAY TO 2035



To combat its current complete dependence on coal, Wheeling Power would add 420 megawatts of solar, 700 megawatts of wind, and 148 megawatts of battery storage capacity from 2021 through 2035. Wheeling Power would also install energy efficiency on the same trajectory as Appalachian Power.

50 Retiring Appalachian Power's share in the Clifty Creek Power Plant and the Kyger Creek Power Plant would necessarily be a complex process due to Appalachian Power sharing its purchase obligations for those plants with multiple utilities under a joint power purchase arrangement with the Ohio Valley Electric Corporation and the Indiana-Kentucky Electric Corporation. Additional complexity exists because of the potential repeal of the "House Bill 6" energy legislation in Ohio and how that could affect these power plants. While many details would need to be worked out, our modeling shows that stepping away from its shares in those power plants in 2024 and 2031 would be the prudent economic choice for Appalachian Power.

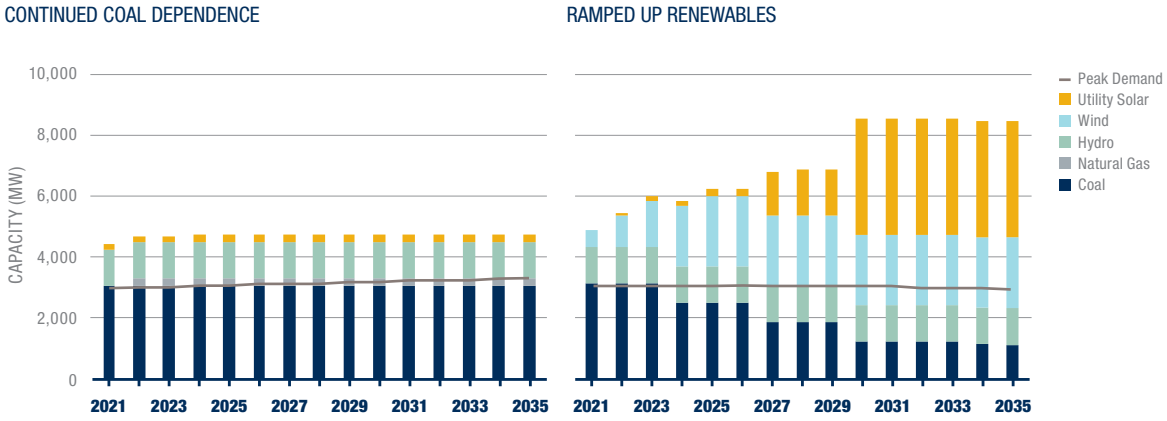
As a product of this diversification of its power resources, Wheeling Power would be able to ramp down Unit 1 of the Mitchell Power Plant and retire it at the end of 2024. Again, we would only propose doing this through an employee- and community-guided process in which Wheeling Power and policymakers ensure new opportunities for workers and the surrounding community.

Similar to Appalachian Power with the Mountaineer Power Plant, Wheeling Power could keep Unit 2 of the Mitchell Power Plant online to enable a more gradual transition and to leave the door open for innovation in the coal industry to address emissions liabilities and regain competitiveness.

Mon Power and Potomac Edison

Mon Power (which additionally supplies the power for Potomac Edison's West Virginia territory) would follow a similar path as Appalachian Power and Wheeling Power under our proposed Ramped Up Renewables scenario.

MON POWER (INCLUDING POTOMAC EDISON):[51] PATHWAY TO 2035



From 2021 through 2035, Mon Power would add 3,820 megawatts of solar, 2,300 megawatts of wind, and 48 megawatts of battery storage capacity. Mon Power's energy efficiency installations would be on the same timeline described above – equal to 0.25 percent of total electric load in 2021, increasing gradually to a level equal to 2.0 percent of total electric load in 2030.

Due to the addition of renewable energy resources and energy efficiency, Mon Power would be able to gradually ramp down and, in 2029, retire the Harrison Power Station. Yet again, we would only advocate proceeding with this move if it was done in a way that involved employees and the affected communities in decision making and ensured that new employment opportunities and community benefits are being created. This also applies to the Grant Town Power Plant, which Mon Power would be able to retire in 2033.

51 See footnote 89 to the Technical Appendix regarding Mon Power's pumped hydro capacity figures.

Lastly, similar to Appalachian Power and Wheeling Power, Mon Power would be able to keep the coal-fired Fort Martin Power Station online. This would enable more gradual transitions for employees and would also allow for the possibility of innovation in the coal industry over the next decade to eliminate emissions liabilities and regain competitiveness.

Ramping Up Renewables Is Cost-Competitive

The cost to West Virginia's electric utilities under each of these two scenarios is very similar. Regardless of which path the electric utility follows — Continued Coal Dependence or Ramped Up Renewables — the cost difference to the electric utility is no more than five percent. The key variable is whether a fee on carbon dioxide emissions is ultimately imposed. If a modest emissions fee is imposed[52] — as is anticipated in the planning processes of most electric utilities[53] — then the Ramped Up Renewables path would provide savings to the utility versus Continued Coal Dependence. Even without an emissions fee, however, the cost difference of the Ramped Up Renewables scenario is no greater than five percent versus Continued Coal Dependence.

Notably, the cost comparisons discussed in this report do not even account for other costs that customers in West Virginia will likely incur in connection with coal-fired power plants as utilities perform upgrades to comply with environmental safeguards. While these additional environmental compliance costs were too uncertain to account for in our modeling, they are real and substantial. According to a recent regulatory filing by FirstEnergy, for example, Mon Power and Potomac Edison expect to incur $247 million in additional capital and maintenance costs just between 2018-2025 to reduce pollution at their West Virginia coal-fired power plants and comply with environmental safeguards.[54] The magnitude of this cost is equal to almost one quarter of the fees that FirstEnergy would pay over the same amount of time if a fee on carbon emissions is imposed, yet it is not even represented in the cost comparison shown below.

COST TO AMERICAN ELECTRIC POWER OF RAMPED UP RENEWABLES

(Appalachian Power & Wheeling Power)

With Emissions Fee:	**2.9% cheaper** than Continued Coal Dependence.
No Emissions Fee:	**Only 4.4% more expensive** than Continued Coal Dependence.

COST TO FIRSTENERGY OF RAMPED UP RENEWABLES

(Mon Power & Potomac Edison)

With Emissions Fee:	**4.3% cheaper** than Continued Coal Dependence.
No Emissions Fee:	**Only 5.0% more expensive** than Continued Coal Dependence.

52 We modeled an emissions fee with the same magnitude and timeline that American Electric Power (the parent company of Appalachian Power) has used in other jurisdictions, specifically for its affiliate Southwestern Electric Power Company in Arkansas. *See* Southwestern Elec. Power Co., *Integrated Resource Planning Report* ES-2, Docket No. 07-011-U (Ark. Pub. Serv. Comm'n Dec. 14, 2018).

53 M. Ahluwalia, Center for Climate and Energy Solutions, *The Business of Pricing Carbon: How Companies Are Pricing Carbon to Mitigate Risks and Prepare for a Low-Carbon Future* 15 (Sept. 2017) ("Sixty three percent of the companies in the utility sector . . . indicated they are using internal carbon pricing and 18 percent plan to do so by 2018.").

54 Monongahela Power Co. and Potomac Edison Co., *Application for Approval of a Modernization, Upgrade, and Improvement Plan for Coal-Fired Boilers at Elec. Power Plants* Exhibit DVS-1, Case No. 20-0666-E-4435T (W. Va. Pub. Serv. Comm'n Aug. 28, 2020).

Given that the cost to our electric utilities of Continued Coal Dependence is similar to the cost of Ramping Up Renewables — and Continued Coal Dependence might even prove significantly more expensive due to emissions fees and costs incurred to reduce pollution — it is important to look at the broader impacts of these two scenarios, including other benefits that Ramped Up Renewables would deliver to West Virginia beyond cost savings.

Ramping up renewable energy and energy efficiency creates jobs – as well as a chance for policymakers to ensure economic opportunities for coal workers and their communities into the future.

Ramping up renewable energy and building a new energy economy in West Virginia would lead directly to job creation.

Just the solar project and energy efficiency installations in the Ramped Up Renewables scenario alone would create the equivalent of almost 3,000 full-time jobs.

Even in a hard-hearted analysis in which one assumes that no measures will be taken to ensure new opportunities for current power plant workers or coal miners,[55] the net employment impact of the Ramped Up Renewables scenario through 2030 is equivalent to the creation of 1,155 full-time jobs. This net calculation is inclusive of all upstream and downstream employment effects of the buildout of renewable energy resources and the gradual retirement of coal-fired power plants.

Looking beyond 2030, the slowdown in the fossil fuel economy — in the absence of deliberate measures to ensure new opportunities for current coal workers — does eventually catch up with and countermand the economic growth from building new renewable energy projects. Specifically, on a net basis, the employment impact in West Virginia from the Ramped Up Renewables scenario is a 0.0002 percent decrease when looking at the full study period of 2021 through 2035.

While West Virginia can proceed with Ramping Up Renewables beginning today and know that the net employment impacts through 2030 will be net positive, our electric utilities should carry out this diversification of our resource portfolio in a way that guarantees new opportunities to current power plant workers.[56] In addition, our policymakers in Charleston and Washington, D.C. should act to secure a federal reinvestment in West Virginia's miners, coal communities, and a new energy economy that ensures their prosperity beyond 2030.[57]

Ramping Up Renewables diversifies our economy and puts us on competitive footing in the regional new energy economy.

Our neighbors like Virginia and Maryland are charging forward with a new energy economy – leading to a major buildout of renewable energy projects and the creation of new energy companies. In contrast, recent headlines regarding the coal industry often include the words "bankruptcy" or

55 We do not advocate for this approach. We believe it is critical that the electric utilities and our policymakers act together — in collaboration with affected workers and communities — to ensure that robust new opportunities are being guaranteed to coal workers and communities.

56 *See Supplemental Brief: We Can Make the Ramping up of Renewable Energy Work for Everyone.*

57 *See Supplemental Brief: West Virginia's Renewable Energy Ramp-up Should Be Complemented by a Federal Reinvestment in Miners, Coal Communities, and Our New Energy Economy.*

"bailout."[58] Ramping up renewable energy and energy efficiency installations by our electric utilities can be one part of an overall strategy to ensure that West Virginia has a robust role in the new energy economy.[59]

Even before embarking on a buildout of renewable energy projects in our own state, we are already seeing the benefits of participating in the renewable energy economy. Recently Governor Jim Justice honored Huntington-based Steel of West Virginia with the Governor's Commendation for International Market Entry Award.[60] In receiving this award, the company was quick to highlight the importance of its customers in the solar industry, stating: "Solar has been a growing industry for us even when some markets we traditionally served have contracted. When you see a big solar farm, you see acres and acres filled with our beams underneath the solar panels."[61] Showing that these sales into the renewable energy economy are meaningful, the general manager of Steel of West Virginia, Chuck Abbott, stated: "This new solar market has been a very important contributor to Steel of West Virginia's ability to provide employment to residents of the Tri-State."[62] Abbott continued, explaining that, "[i]n addition to our 550 employees who are melting and rolling right here in Huntington the steel beams used for these solar farms, our parent company, Steel Dynamics, has invested $18 million and created over 100 new Tri-State jobs involving the fabrication and coating of this product."[63]

By ramping up renewable energy and energy efficiency in West Virginia, we can expand our participation in the renewable energy economy and further contribute to the growth and employment by companies like Steel of West Virginia that supply to the renewable energy industry. Moreover, as major companies in the renewable energy industry commit to producing their own products with renewable energy,[64] it is important that our manufacturers and suppliers in West Virginia have access to renewable energy.

> "Solar has been a growing industry for us even when some markets we traditionally served have contracted. When you see a big solar farm, you see acres and acres filled with our beams underneath the solar panels."
>
> **- STEEL OF WEST VIRGINIA, HUNTINGTON, WV**

58 *See, e.g.*, L. Legere and A. Litvak, *Coal's outlook darkens as Appalachian companies idle mines, declare bankruptcy, Pittsburgh Post-Gazette (Apr. 20, 2020); S. Bowman, Analysts say new 'coal bailout' could hike customer bills and keep coal plants running*, Indianapolis Star (Jan. 21, 2020).

59 Additional aspects of this strategy may include industrial carbon capture and utilization, industrial energy efficiency, and the production of low-emission building materials, as have been promoted by our congressional delegation. *See, e.g.*, S. 2300, *Clean Indus. Tech. Act of 2019* (116th Cong.) (co-sponsored by Sen. Capito and Sen. Manchin); H.R. 3978, *Clean Indus. Tech. Act of 2019* (116th Cong.) (co-sponsored by Rep. McKinley); S. 383, *USE IT Act* (116th Cong.) (co-sponsored by Sen. Capito and Sen. Manchin); H.R. 1166, *USE IT Act* (116th Cong.) (co-sponsored by Rep. McKinley); S. 1201, *EFFECT Act of 2019* (116th Cong.) (sponsored by Sen. Manchin) (co-sponsored by Sen. Capito); H.R. 5865, *CCUS Innovation Act* (116th Cong.) (sponsored by Rep. McKinley); S. 2137, *Energy Savings and Indus. Competitiveness Act of 2019* (116th Cong.) (co-sponsored by Sen. Manchin).

60 F. Pace, *Three Huntington businesses honored for exporting to new countries*, Huntington Herald-Dispatch (Aug. 28, 2020).

61 *Id.*

62 *Id.*

63 *Id.*

64 *See, e.g.*, L. Stoker, *JinkoSolar, First Solar unveil 100% renewable power pledges*, PV-Tech (Aug. 6, 2020).

CAN WE BUILD THAT MUCH SOLAR IN THE MOUNTAIN STATE? YES

Probably because so few large solar farms have been constructed in West Virginia to date, many West Virginians understandably ask: Can we even build that much solar in the Mountain State?

The answer is "Yes" — both in terms of our solar resources and our available land.

SOLAR RESOURCES

West Virginia is not California. And fortunately, we don't have to be.

While it's true that California has constructed far more solar power plants than any other state in the Union, our almost-neighbor North Carolina is number two.[65] In fact, North Carolina has already built 6.5 gigawatts of solar.[66] That's pretty close to the approximately 8.2 gigawatts of solar that we are proposing to build in West Virginia over a fifteen-year period.

West Virginia isn't quite as sunny as North Carolina, but it's significantly sunnier than Germany where by the end of 2016 the State of Bavaria (which is similar in size to West Virginia) already installed significantly more solar energy than we are proposing to build by 2035.[67]

AVAILABLE LAND

Mountains and hollers are the beautiful defining traits of our state, but they admittedly aren't ideal for laying down a large solar farm. Anticipating this challenge, Downstream Strategies analyzed in 2017 whether brownfield sites in West Virginia — for example, abandoned mine lands, landfills, and former industrial sites — could serve as feasible locations for solar farms. They identified at least 140,160 acres of brownfield sites that are viable for large solar energy installations.[68] The approximately 8.2 gigawatts of solar energy installations that we are proposing would only require roughly 64,780 acres for construction.[69] This means that Ramping Up Renewables could feasibly occur without even breaking ground on greenfield sites. We'll leave it to the developers of renewable energy projects to decide precisely the best location to build a project at the lowest cost. Suffice it to say, however, that concerns over the availability of land should not hold up the Ramping Up of Renewables.

65 Solar Energy Indus. Ass'n, *Top 10 Solar States* (2020), available at https://www.seia.org/research-resources/top-10-solar-states-0.

66 *Id.*

67 *See* World Bank Group, *Solar Resource Map: Photovoltaic Power Potential* (2019), available at https://solargis.com/maps-and-gis-data/download/world; Strom-Report, *Photovoltaik in Deutschland* (2016), available at https://strom-report.de/photovoltaik/#photovoltaik-deutschland-verteilung.

68 *See* Downstream Strategies, *Prospects for Large-scale Solar on Degraded Land in West Virginia* (Feb. 2017).

69 *See* Nat'l Renewable Energy Lab., *Land-Use Requirements for Solar Power Plants in the United States* (June 2013).

Ramping up renewable energy retains future opportunities for the coal economy.

As discussed above, despite the increasing difficulty that coal power plants have in competing on price against renewable energy,[70] our proposed Ramped Up Renewables scenario retains the Fort Martin Power Station and the Mountaineer Power Plant, as well as Unit 2 of the Mitchell Power Plant. This approach not only allows for a more gradual transition in which our electric utilities and policymakers can ensure that power plant workers and their communities have new opportunities and benefits, it also leaves the door open for the coal industry to develop new technologies over the next decade and restore its competitive position following recent challenges.

If technologies to address the emissions liabilities at coal-fired power plants become economically competitive over the next decade, these power plants will stand ready to deploy those technologies (or, if more economical, be replaced with them). Even if such technologies do not become cost competitive over the next decade, keeping these power plants online for now will have maintained a lifeline for the coal industry while it develops new economically competitive technologies. This evolution of the coal industry is being supported by each member of our congressional delegation through the COAL TeCC Act ("Creating Opportunities and Leveraging Technologies for Coal Carbon Act").[71] This proposed legislation would support the development of new coal-derived technologies and materials like advanced carbon fiber and building materials.[72]

Debates over energy in the past have often descended into over-simplified "all-or-nothing," "for-or-against" shouting matches. We propose a prudent approach that reduces our current complete dependence on coal while also maintaining an opportunity for the coal industry to evolve and compete in the new energy economy.

Ramping up renewable energy creates no additional liabilities for emission costs and reduces exposure to fuel costs.

Because our proposed Ramped Up Renewables scenario does not build any new fossil fuel power plants, it avoids creating any new potential liabilities for emission costs, and it also reduces our exposure to variability in fuel costs.

As discussed in the *Background* section of this report, we do not know whether and how carbon dioxide emissions might be regulated in the future. We do know, however, that support for federal action to reduce emissions is strong and growing on a bipartisan basis. In light of the multiple bipartisan proposals being considered for reducing emissions by imposing a fee on carbon dioxide emissions, our Ramped Up Renewables scenario avoids adding to the bill we would face under such proposals by not building any new fossil fuel power plants.

We also do not know how much the fuel for fossil fuel power plants will cost in the future. In contrast, the capital costs for renewable energy facilities are known in advance, and fortunately there is no fuel cost to be incurred subsequently for the sunshine or the wind. By not building new fossil power

70 By 2025, it is estimated that 86 percent of coal-fired power plants in the United States could be replaced by nearby renewable energy with immediate cost savings. E. Gimon *et al, Coal Cost Crossover: Economic Viability of Existing Coal Compared to New Local Wind and Solar* 1-2 (Mar. 2019). See the *Background* section of this report for greater detail.

71 S.B. 3047, *Creating Opportunities And Leveraging Technologies for Coal Carbon Act of 2019*, 116th Cong.; H.R. 5704, *COAL TeCC Act of 2020*, 116th Cong.

72 *Bipartisan bill to promote coal-derived products introduced*, WDTV (Dec. 13, 2019).

plants, the Ramped Up Renewables scenario provides certainty and avoids the possibility of facing spikes in fuel costs down the road.

Ramping Up Renewables results in major additional savings from avoided healthcare costs.

Not included in the direct costs to the electric utilities shown above are the billions of dollars in savings that we would achieve by avoiding illnesses and healthcare costs under the Ramped Up Renewables scenario.

Just the reduced emissions in the Ramped Up Renewables scenario in 2021 alone are estimated to result in full lifecycle avoided health impacts equal to $221 to $501 million throughout the region. As more renewable energy resources are added in 2025, the reduced emissions in that year alone are estimated to result in full lifecycle avoided health impacts equal to $987 million to $2.2 billion. By 2035, the drastic reduction in emissions just in that year alone between the two scenarios is estimated to result in full lifecycle avoided health impacts equal to $1.5 billion to $3.3 billion.

CONCLUSION

Ramping Up Renewables would decrease our current dependence on coal by significantly diversifying our resource portfolio with additions of solar, wind, and energy efficiency. The cost to our utilities of doing so is comparable to the cost of their current trajectories, but the benefits to West Virginians are considerable. In addition to avoiding billions of dollars in healthcare costs in the region, West Virginians would join in the growth of the renewable energy industry and ensure West Virginia's place in the new energy economy.

4 SUPPLEMENTAL BRIEFS

WEST VIRGINIA'S RENEWABLE ENERGY RAMP-UP SHOULD BE COMPLEMENTED BY A FEDERAL REINVESTMENT IN MINERS, COAL COMMUNITIES, AND OUR NEW ENERGY ECONOMY

As set forth in the main section of our report,[73] West Virginia can begin ramping up renewable energy today, and doing so would be cost-competitive and create new job opportunities for many. In the absence of an additional investment in West Virginia's coal workers and coal communities, however, the net long-term impact on the overall state economy will be flat. This is because the slowdown in the fossil fuel economy will eventually catch up with and countermand the economic growth from the renewable energy and energy efficiency buildout.

We believe that West Virginians — especially coal workers and their communities — deserve better than to "break even" in the transition to a new energy economy.

Mountaineers made an essential contribution to America's economic rise in the 19th and 20th centuries through the mining, combustion, and transportation of coal. It's critical that this contribution be honored in two ways: First, by protecting the livelihoods and health of the individuals, families, and communities that sacrificed to make this contribution. Second, by securing the participation of coal communities in the new energy economy that is being built with renewable energy, energy efficiency, industrial carbon capture and utilization, and advanced manufacturing.

As Congress weighs bipartisan proposals for a carbon fee and dividend (among other proposals for federal action on emissions), we suggest that our congressional leaders should consider withholding their support for any such proposal unless the legislation is paired with a federal reinvestment in West Virginia that honors the contributions of our coal communities and secures West Virginia's role in the new energy economy.

73 *See Findings: Ramping Up Renewable Energy Beats Continued Dependence on Coal.*

Examples of potential actions to honor the contributions of West Virginians in the coal economy and secure West Virginia's future in the new energy economy include the following:

HONORING THE CONTRIBUTIONS OF MINERS AND COAL COMMUNITIES	SECURING WEST VIRGINIA'S ROLE IN THE NEW ENERGY ECONOMY
Guarantee of Miner Pensions, Healthcare, and Black Lung Benefits	Low-Cost Loans (or Loan Guarantees) to Enable Legacy Power Plant Retirement and Replacement[74]
Full Funding for Mine Remediation and Reclamation; Increased Funding for Brownfield Redevelopment in Coal Communities	Incentives for Renewable Energy Projects Built in Coal Communities
Job Creation Through Plugging and Remediation of Abandoned Oil and Gas Wells	Incentives for Emission-Reducing Manufacturing Facility Investments in Coal Communities
Expanded Investment in Coal Communities through the Appalachian Regional Commission and Economic Development Administration	Steering of Emission-Reducing Energy and Industrial RD&D into Coal Communities
Consideration of Relocating the Appalachian Regional Commission to West Virginia	Expand Residential Weatherization Assistance and Reauthorize Energy Efficiency Block Grants for Coal Communities
Transitional Support for State and Local Tax Revenue Losses (similar to the CARES Act Coronavirus Relief Fund)	Expansion of the National Energy Technology Laboratory (Morgantown) and Designation as a Hub for CCUS and Advanced Hydrogen Initiatives
Investment in the National Coal Heritage Area	Designation of the Industrial Assessment Center at West Virginia University as a Center of Excellence for Industrial Emission-Reducing Technologies
	Investment in the Robert C. Byrd Institute, Mid-Atlantic Aerospace Complex, and Their Partners to Ensure West Virginia's Role in Low-Emission Aviation

Securing a reinvestment in coal communities and West Virginia's energy economy will ensure that Ramping Up Renewables creates net positive employment effects not only through 2030 but also beyond.

As just one small example of how a federal reinvestment in West Virginia's energy economy could supercharge the economic effect of Ramping Up Renewables, we modeled the impact of building that scenario's proposed wind farms in West Virginia instead of Indiana and Illinois.[75] The result was an additional 1,267 jobs and $1.2 billion in personal income created in West Virginia from the Ramped Up Renewables scenario. This example is indicative of the type of energy future that West Virginia's congressional leaders could deliver in connection with any carbon fee proposal.

74 This could enable the refinancing process described in *Supplemental Brief: We Can Make the Ramping up of Renewable Energy Work for Everyone*.

75 Due to the current lower cost of wind energy from Indiana and Illinois, our modeling software preferred to incorporate energy from wind facilities in those states instead of from West Virginia.

Rather than being a threat to West Virginia workers and communities, proposals being considered to address climate change and reduce emissions could provide an opportunity for securing West Virginia's place in the new energy economy. We urge our policymakers to consider making the most of this opportunity.

WE CAN MAKE THE RAMPING UP OF RENEWABLE ENERGY WORK FOR EVERYONE

In addition to simply keeping the lights on, a plan for West Virginia's energy future must also keep costs down for customers, ensure the livelihoods of power plant workers, keep tax revenues flowing to power plant communities that depend on them, and maintain financial viability for the electric utilities.

Especially if reinforced with a federal reinvestment in West Virginia,[76] the ramping up of renewable energy and energy efficiency in West Virginia can be pursued in a way that works for everyone.

Keeping Costs Down & Maintaining Financial Viability for Utilities

As described in the main body of our report, the cost to our electric utilities of Ramping Up Renewables is comparable to the cost of Continued Coal Dependence. If a modest emissions fee ends up being imposed toward the end of this decade, then Ramped Up Renewables will be a few percentage points cheaper than Continued Coal Dependence. If an emissions fee is not imposed, then Continued Coal Dependence will be a few percentage points cheaper. The difficulty of paying for Ramped Up Renewables, therefore, is not in its expense but in the complexity of replacing existing costly assets with new affordable assets. Fortunately, West Virginia is not the first state or community to confront this challenge.

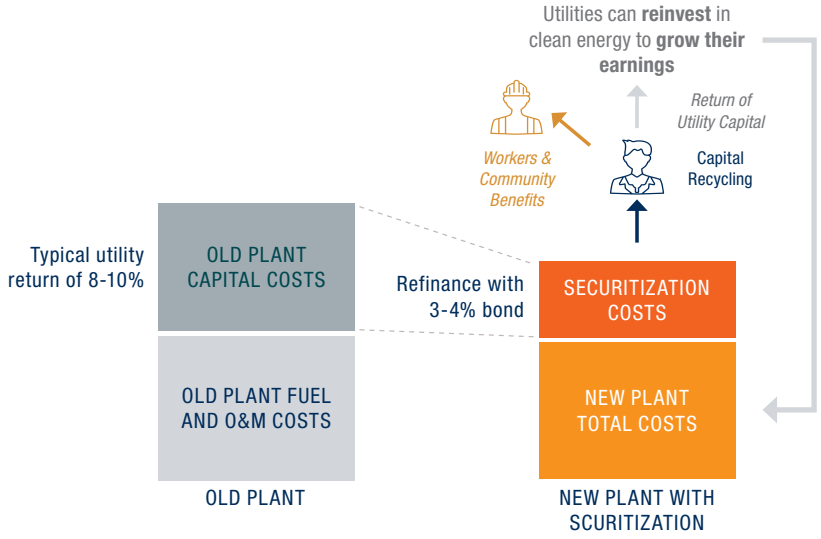
When transitioning from coal-fired power plants to new renewable energy facilities, other states[77] have benefitted from a tool commonly referred to as securitization but more easily understood as a refinancing. The key ingredient in this process is paying off the remaining cost of a retiring power plant with low-cost debt,[78] which allows the utility to shrink the amount that customers are paying for the old power plant. Simultaneously, the utility then no longer has fuel, operations, and maintenance costs for the old power plant because it has been retired. Using the savings from low-cost debt and eliminated operations costs, the utility is able to finance and build new renewable energy projects.

76 We believe that West Virginia's state-level plan for its energy future should be buttressed with a federal reinvestment that further secures the well-being of workers and coal communities. *See Supplemental Brief: West Virginia's Renewable Energy Ramp-up Should Be Complemented by a Federal Reinvestment in Miners, Coal Communities, and Our New Energy Economy.*

77 The clearest example is New Mexico. In 2019, New Mexico enacted the Energy Transition Act. N.M. Stat. Ann. §§ 62-18-1 et seq. The legislation allows electric utilities in New Mexico to refinance their longstanding obligations relating to existing fossil fuel power plants, develop replacement low-emission power resources, and invest in economic diversification and job training in affected communities.

78 Typically this low-cost debt is enabled through a state-level statutorily backed mechanism that ensures a utility's customers will pay back the debt over time through electric bill surcharges. The cost of this debt is lower than usual rate-based financing because virtually all uncertainty regarding repayment is removed. Specifically, uncertainty is eliminated with respect to the level of customer rates in the future and the possibility of a regulator's disallowance of the utility's cost recovery through rates. New Mexico's Energy Transition Act provides an example of this type of legislatively backed mechanism for refinancing with low-cost debt. Loans or loan guarantees from the U.S. Department of Energy could serve as an alternative form of low-cost debt. This would eliminate the need to enact legislation in West Virginia to enable securitization.

The illustration below[79] demonstrates the basic concepts of this refinancing tool:



In addition to keeping costs down for customers, a refinanced transition from old assets to new ones as described above also maintains financial stability for utilities. The capital balance for the old power plant is replaced with a similar or larger capital balance for new renewable energy projects. This is important because utilities only receive a financial return (through customer rates) on capital balances and not on fuel, operations, and maintenance costs. Savings for customers are maintained through the low-cost refinancing and the reduction of costs.

Ensuring Opportunities for Workers and Stability for Communities

The other important stakeholders in this transition are workers and communities. Our current power plants are not only major employers, they are also significant contributors to local government revenues that support vital services. Therefore, as discussed in the main section of our report,[80] the processes to ramp down and retire any existing power plants must be employee-guided and community-empowering.

Specifically, employees should be given new opportunities. Some opportunities will be created directly on-site through the decommissioning of old power plants. Others will be created through the construction of new projects and through electrification and grid modernization efforts. The details of these new opportunities will need to be further developed through a long-term, employee-guided process. The important thing for now is that the starting point for these processes should be that every affected power plant worker will be afforded a new opportunity.

Our electric utilities should additionally take efforts to reinvest in communities that are currently home to power plants by building new renewable energy projects there. Doing so would help to maintain important tax revenues and also make sure that these communities are part of the new energy economy.

79 Adapted (with permission) from an illustration provided by the Rocky Mountain Institute.
80 See *Findings: Ramping Up Renewable Energy Beats Continued Dependence on Coal.*

5 TECHNICAL APPENDIX

PREPARED FOR GRIDLAB AND THE CENTER FOR ENERGY AND SUSTAINABLE DEVELOPMENT AT WEST VIRGINIA UNIVERSITY COLLEGE OF LAW

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1 SCENARIO ANALYSIS

Synapse used the EnCompass capacity expansion and production cost model, licensed from Anchor Power Solutions, to examine two different scenarios over the 15-year analysis period from 2021 to 2035.[81] The EnCompass model combines information about forecasted peak and annual energy demand together with the capital and operating costs of new and existing resources to produce an optimal, least-cost resource portfolio and generation mix. Specifically, the model does the following: (1) builds new resources when necessary to meet peak demand plus a required reserve margin; (2) simulates economic dispatch of the various generating resources; and (3) calculates the total cost (capital and operating) of the respective resource portfolio options, referred to as the utility's revenue requirement.

Our modeling focused on two scenarios, **"Continued Coal Dependence"** and **"Ramped Up Renewables,"** and examined three West Virginia utilities: Appalachian Power Company ("APCo"), FirstEnergy (consisting of MonPower and Potomac Edison), and Wheeling Power Company ("Wheeling Power"). In the first scenario, Continued Coal Dependence, all of the West Virginia coal plants remain in operation over the next 15 years. For APCo specifically, additional renewable capacity that the company plans to bring online between now and 2035, based on the recently completed Virginia integrated resource plan (IRP) in 2019, is included as part of the modeling. The FirstEnergy and Wheeling Power IRPs were last conducted in 2015, and so new renewable and gas resources were allowed to be built in these territories to meet possible energy and capacity needs. The EnCompass model calculates the cost to operate these existing resources and adds additional resources as necessary over the analysis period to meet peak and annual energy requirements.

The second scenario, Ramped Up Renewables, assumes that select coal units are retired over the 2021 to 2035 study period. The replacement options to meet capacity and generation needs were limited to renewable and storage resources, which is consistent with the electric utilities' goals to reduce carbon emissions.[82]

Synapse analyzed the impacts of each of these scenarios on each of the utilities' revenue requirements, annual capacity, annual energy mix, and CO_2 emissions. We provide details on these scenarios and impacts below.

CONTINUED COAL DEPENDENCE

For FirstEnergy and Wheeling Power, Continued Coal Dependence uses input assumptions from the prior 2015 West Virginia IRPs conducted by each of these companies. For APCo, the inputs assumptions are based on the company's 2019 Virginia IRP. Specifically, the Continued Coal Dependence scenario assumes the following:

81 Capacity and production cost models like EnCompass are used to simulate future utility operations under different scenarios to help determine the best strategy for minimizing costs and risks while meeting all relevant constraints such as reliability and transmission availability.

82 Those targets are 90 percent below 2005 levels by 2045 for FirstEnergy and 70 percent below 2000 levels by 2030, 80 percent below 2000 levels by 2050 for American Electric Power (the parent company of APCo and Wheeling Power).

- Peak load and annual energy between 2021 and 2035 are based on the most recent IRP conducted by each of the entities and recent EIA 861 sales data.
- Unit retirements follow the utility IRPs, and no coal units are retired over the course of the analysis period.
- Coal units in West Virginia are designated as "must-run" units, which causes the EnCompass model to simulate historical patterns of coal plant dispatch.
- Ongoing capital expenditures were added for each of the coal units based on a regression equation developed by Sargent & Lundy for the U.S. Energy Information Administration's Annual Energy Outlook 2019.[83,84]
- Renewable additions include:
  + *1,500 MW of solar and 300 MW of onshore wind by 2033 in APCo based on the 2019 IRP filed in Virginia.*
  + *10 MW of battery storage and 34 MW of distributed generation by 2033 in APCo based on the 2019 IRP filed in Virginia.*
  + *100 MW of solar added in both APCo and FirstEnergy in accordance with West Virginia's recent Senate Bill 583 legislation.*
  + *Optimized additions that allow the utilities to meet their reserve margins.*
- Renewable costs in 2021 are based on 2019 NREL ATB Low-Case scenario. Synapse applied the cost decline trajectory from NREL's Mid-Case scenario.[85]
- Resource options offered to the EnCompass model for replacement capacity and energy include generic utility-scale solar, storage, wind, and paired solar-plus-storage resources. EnCompass is allowed to build new gas units in the Continued Coal Dependence scenario.
- Gas prices come from the APCo VA 2019 IRP.
- EnCompass does not allow for capacity and energy imports and exports in order to avoid a possible overreliance on the PJM market to meet projected needs.

RAMPED UP RENEWABLES

The Ramped Up Renewables scenario includes the input assumptions listed above, with the following changes:

- **Coal Units were retired based on the following schedule, with retirements occurring on December 31 in the year listed:**
  - APCo Retirements:

83 U.S. Energy Information Administration. 2019. Assumptions to the Annual Energy Outlook 2019: Electricity Market Module. Page 14. Available at: https://www.eia.gov/outlooks/aeo/assumptions/pdf/electricity.pdf.

84 Synapse did not include any capital expenditures associated with current or upcoming environmental regulations, including, but not limited to, MATS, CSAPR, CCR, or ELG.

85 National Renewable Energy Laboratory (NREL), 2019 Annual Technology Baseline, available at: https://atb.nrel.gov/. This approach tracks closely with recently signed renewable power purchase agreement prices. This method has also been employed in recent studies, such as the 2035 Report, and similarly aligns closely with the 2020 NREL ATB Mid-Case cost projections.

    + *Clifty Creek in 2024*
    + *John Amos 1 in 2022*
    + *John Amos 2 in 2025*
    + *John Amos 3 in 2028*
    + *Kyger Creek in 2031*
- **FirstEnergy Retirements:**
    + *Harrison 1 in 2023*
    + *Harrison 2 in 2026*
    + *Harrison 3 in 2029*
    + *Grant Town in 2033*
- **Wheeling Power Retirements**
    + *Mitchell 1 in 2024*
- **Minimum required renewable energy generation thresholds of 30 percent by 2030 and 50 percent by 2035.**
- **No new plants that emit CO_2 are allowed, to avoid creating new emissions liabilities.**
- **Ongoing capital expenditures were adjusted to account for lower spending for coal units that are approaching retirement.**
- **"Must-run" designations for coal plants were removed to allow for economic dispatch.**
- **In addition to the renewable resources available in Continued Coal Dependence, additional wind is available in Ramped Up Renewables, modeled in the form of a power purchase agreement (PPA) with Indiana or Illinois wind farms based on recent price data ($29/MWh).[86]**
- **Energy efficiency is assumed at 0.25 percent starting in 2021 with annual incremental savings of 0.15 percent per year and caps at 2 percent of baseline load in 2033.**
- **200 MW of solar (instead of 100 MW) added in both APCo and FirstEnergy in accordance with Senate Bill 583.**

86 See the summary of bids resulting from the NIPSCO all-source RFP, available at: https://pv-magazine-usa.com/2019/08/29/indiana-gas-plant-spurned-wind-solar-and-storage-respond/

2 ELECTRIC SECTOR MODELING RESULTS

Synapse used the EnCompass model to compare Continued Coal Dependence to Ramped Up Renewables. In the Ramped Up Renewables scenario, new renewable resources were built by the model as existing coal units retired, minimizing capital and operating costs to customers in each utility service territory. This section describes the results of that modeling with respect to the changing capacity mix and resulting electricity generation in the two modeled scenarios.

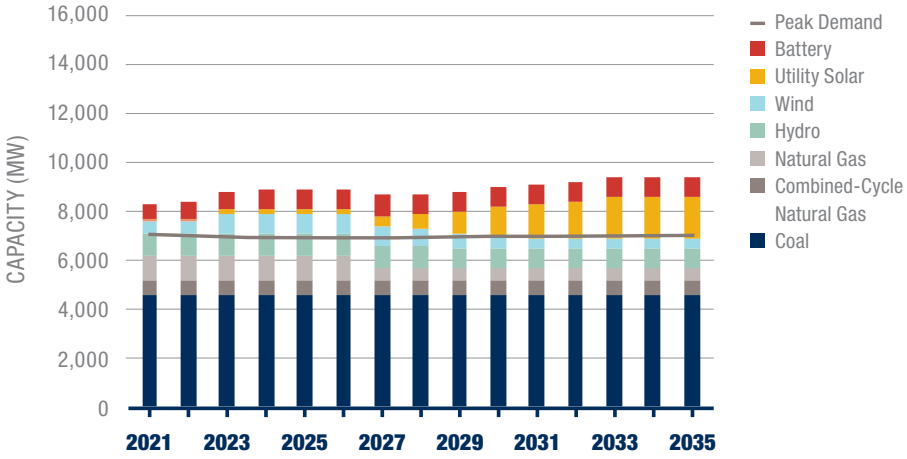
2.1. CAPACITY RESULTS

West Virginia's current capacity mix is dominated by fossil-fueled generating units with coal- and gas-fired units making up most of the portfolio. The capacity resources in Continued Coal Dependence and Ramped Up Renewables are shown by utility in the following sections.

APPALACHIAN POWER COMPANY

APCo's capacity mix in Continued Coal Dependence is shown in Figure 1.[87] Coal makes up 54 percent of the total capacity in the first year of the analysis period, while gas-fired resources make up 20 percent, and renewables and storage make up the remaining 25 percent. Beginning in 2027, coal and gas capacities remain constant in terms of megawatts but make up a smaller part of the overall contribution to total capacity due to solar and wind additions taken from the 2019 IRP in Virginia.

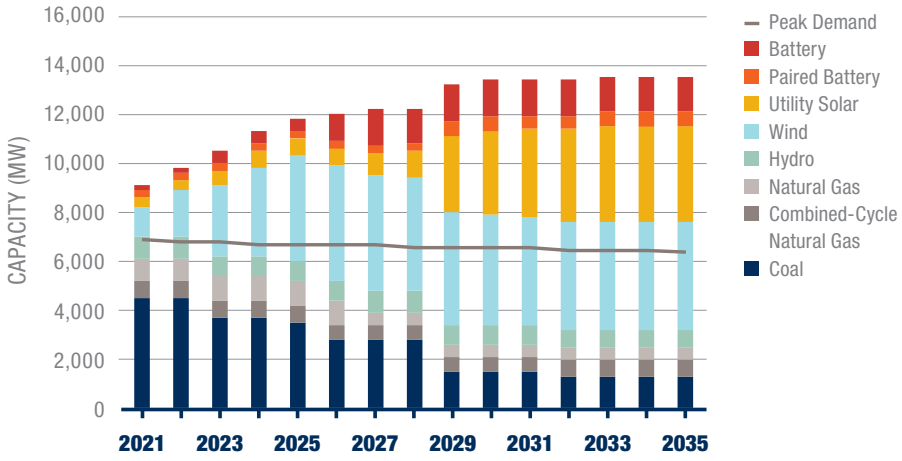
FIGURE 1. APCO NAMEPLATE CAPACITY, CONTINUED COAL DEPENDENCE[88]



87 Gas-fired combined cycle units are differentiated from gas-fired steam turbines and combustion turbines.
88 Pumped hydro has been included under the "Hydro" category in this chart and all subsequent charts.

APCo's capacity mix in Ramped Up Renewables is shown in Figure 2. While the 2021 starting point is the same for both cases, a growing volume of renewable capacity (solar and wind) replaces retiring coal over the course of the analysis period. In 2035, wind and solar make up 32 percent and 29 percent of total capacity, respectively, whereas coal and gas make up a combined total of 18 percent (9 percent each) of nameplate capacity.

FIGURE 2. APCO NAMEPLATE CAPACITY, RAMPED UP RENEWABLES



FIRSTENERGY

Figure 3 shows nameplate capacity in Continued Coal Dependence for FirstEnergy. The resource mix is less diverse than in APCo, and in 2021, coal makes up 70 percent of the total capacity while pumped hydro makes up 27 percent.[89] Over the course of the analysis period, the model builds a small amount of solar and adds one gas combustion turbine. As a result, gas and solar are each 5 percent of the total capacity, while coal and pumped hydro have declined slightly as a percentage of total capacity by 2035.

FIGURE 3. FIRSTENERGY NAMEPLATE CAPACITY, CONTINUED COAL DEPENDENCE[90]

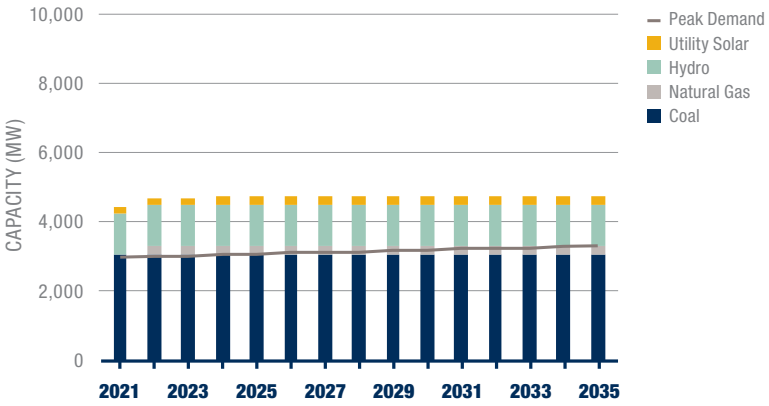


FIGURE 4. FIRSTENERGY NAMEPLATE CAPACITY, RAMPED UP RENEWABLES[92]

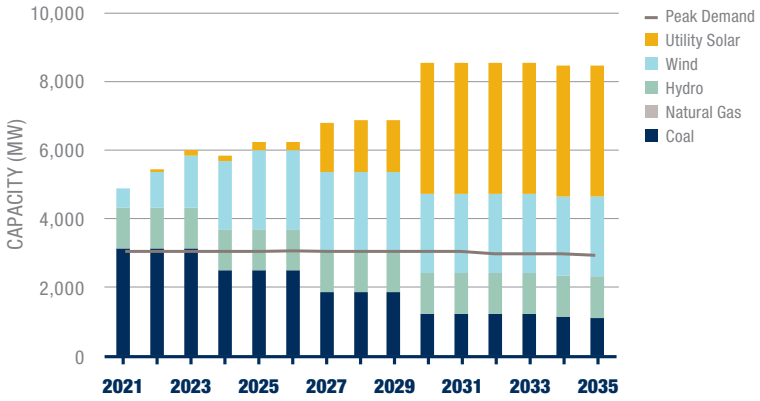


Figure 4 shows the capacity for Ramped Up Renewables. We see that the EnCompass model adds wind capacity to the mix as soon as it becomes available, starting in 2021. Energy from wind is less expensive than running FirstEnergy's own coal units, and the model selects new wind PPAs to displace a portion of the more expensive coal-fired generation. In 2035, solar makes up 45 percent of the total capacity while wind is 27 percent of total capacity. Pumped hydro and coal make up a much smaller fraction of the total capacity at 14 percent and 13 percent, respectively.[91]

89 The capacity inputs for FirstEnergy have not been updated to reflect FirstEnergy's sale of a portion of its interest in the Bath County Pumped Storage Station, which reduced MonPower's partial interest in that facility to 487 MW. Implementing this update to MonPower's capacity inputs will not have a large impact on the modeling comparison of the Continued Coal Dependence scenario and the Ramped Up Renewables scenario because the same amount of replacement capacity will be needed in both scenarios.

90 *See* footnote 89 to this Technical Appendix regarding the pumped hydro capacity displayed in this chart.

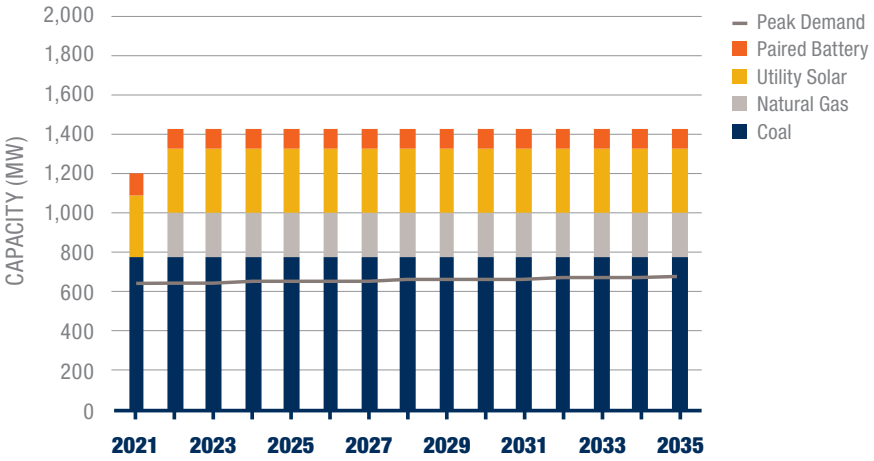
91 *See* footnote 89 to this Technical Appendix regarding pumped hydro capacity.

92 *See* footnote 89 to this Technical Appendix regarding the pumped hydro capacity displayed in this chart.

WHEELING POWER

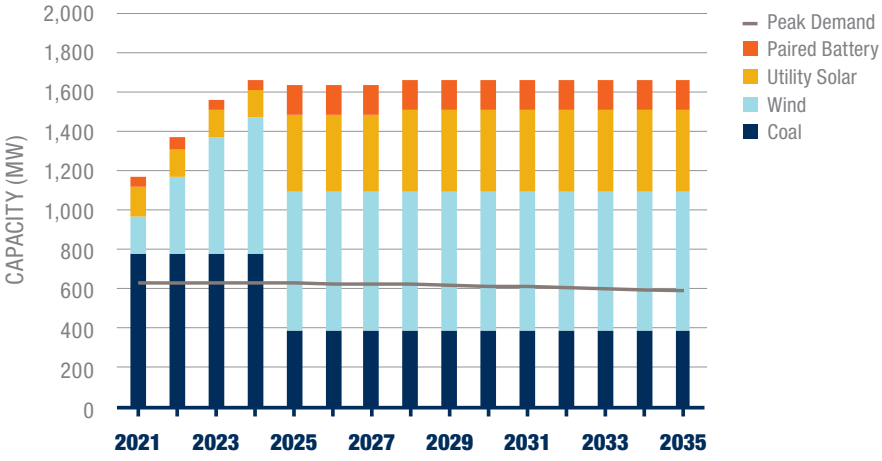
Wheeling Power is unique in this analysis because the only asset owned by the utility is 50 percent of the coal-fired Mitchell Plant, as of the release of this report. Thus, coal capacity currently makes up 100 percent of Wheeling Power's capacity mix. Figure 5 and Figure 6 show the capacity for Wheeling Power in Continued Coal Dependence and Ramped Up Renewables, respectively, over the course of the analysis period. In Continued Coal Dependence, the model adds solar resources and a single combustion turbine. By 2035, coal makes up 54 percent of capacity while gas makes up 16 percent, with solar and battery storage making up the remainder.

FIGURE 5. WHEELING POWER NAMEPLATE CAPACITY, CONTINUED COAL DEPENDENCE



In Ramped Up Renewables, one of the two Mitchell coal units is retired (at the end of 2024). By the end of the study period, coal makes up 24 percent of total capacity, wind is 42 percent, solar makes up 25 percent, and battery storage makes up the remaining 9 percent.

FIGURE 6. WHEELING POWER NAMEPLATE CAPACITY, RAMPED UP RENEWABLES



We see from the Ramped Up Renewables results for each of the three utilities that wind and solar both play an important role in replacing coal capacity that is retiring over the duration of the analysis period. Even in the early years when no capacity deficit exists, the EnCompass model chooses to add these resources, to the extent that it can, in order to displace more expensive generation from existing coal units with zero-variable cost, zero-emissions energy from wind and solar. In APCo and FirstEnergy, we also see the addition of battery storage resources to meet capacity deficits, and to store energy from wind and solar resources for discharge during hours in which this generation is needed.

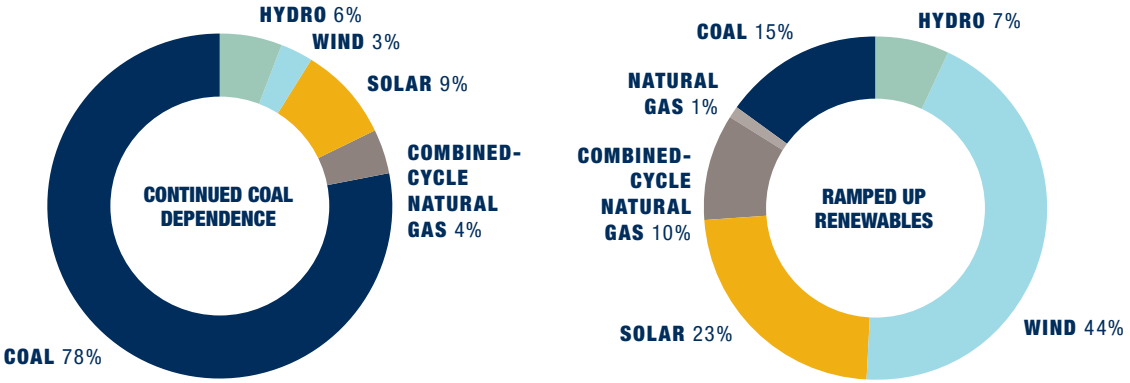
2.2. GENERATION RESULTS

In this section, we present the generation results for each of the utilities in the two modeled scenarios.

APPALACHIAN POWER COMPANY

In APCo, Ramped Up Renewables is characterized by a large volume of renewables in 2035 when compared with Continued Coal Dependence, as shown in Figure 7. Not only do several of the utility's coal units retire, but the removal of the "must-run" designations allow the units to dispatch economically. Generation from the coal units falls as a result and is filled in by zero-variable cost wind and solar generation. In 2035, solar and wind generation make up 67 percent of generation in Ramped Up Renewables, as compared to only 12 percent in Continued Coal Dependence.

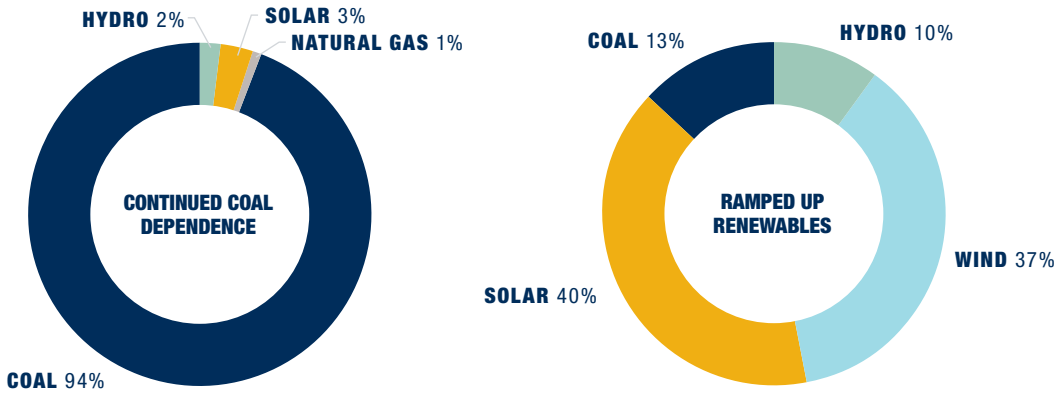
FIGURE 7. APCO GENERATION IN 2035, BY SCENARIO



FIRSTENERGY

Figure 8 compares the generation in FirstEnergy's service territory under Continued Coal Dependence and Ramped Up Renewables. The transformation is even more dramatic than that of APCo. In Continued Coal Dependence, 95 percent of FirstEnergy's generation comes from fossil fuels, with 94 percent of that coming from coal. In contrast, in Ramped Up Renewables, coal makes up only 13 percent of generation, with wind and solar making up a total of 77 percent in 2035.

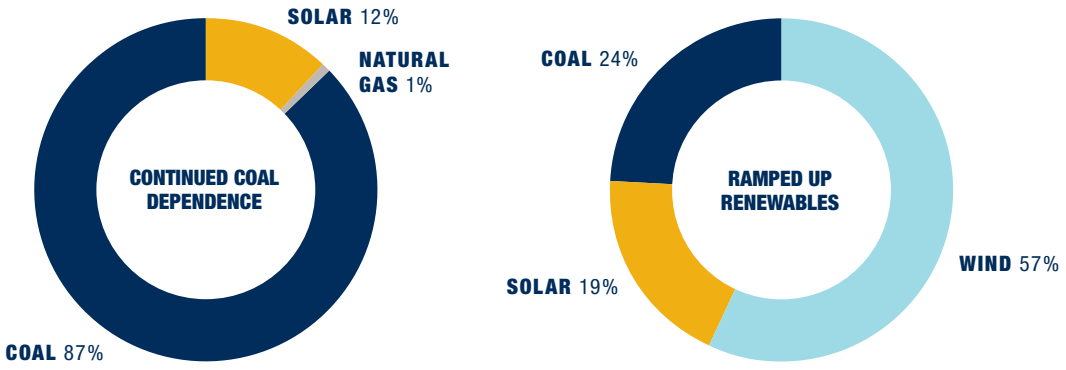
FIGURE 8. FIRSTENERGY GENERATION IN 2035, BY SCENARIO[93]



WHEELING POWER

Figure 9 shows the generation mix for Wheeling Power. In Continued Coal Dependence, fossil fuels make up 88 percent of the generation mix. Solar makes up 12 percent of generation in both cases. However, in Ramped Up Renewables, wind grows to become 57 percent of the total and coal falls to 24 percent.

FIGURE 9. WHEELING POWER GENERATION IN 2035, BY SCENARIO



93 *See* footnote 89 to this Technical Appendix regarding the modeling of pumped hydro.

While not shown in the generation charts, the battery storage resources added in Ramped Up Renewables are able to store excess renewable energy produced over the course of a day and dispatch that energy during the hours in which it is needed.

2.3. CARBON DIOXIDE EMISSIONS

Emissions in the Continued Coal Dependence scenario decline slightly in the case of APCo over the analysis period due to declining load and the renewable additions that are included for compliance with Virginia's recently implemented Clean Economy Act. There is a slight increase in emissions for FirstEnergy and Wheeling Power due to increases in load over the analysis period. Predictably, annual emissions of CO_2 decline dramatically through 2035 in the Ramped Up Renewables scenarios for each of the utilities in this analysis, as renewables displace generation from coal, as shown in Figure 10, Figure 11, and Figure 12. In the case of APCo and First Energy, which have company-wide emissions targets, Ramped Up Renewables meets those emission reduction targets in their West Virginia service territories.

FIGURE 10. APCO EMISSIONS OF CO_2 IN THE TWO MODELED SCENARIOS

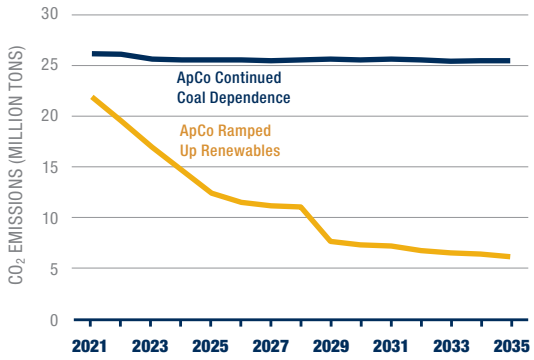


FIGURE 11. FIRSTENERGY EMISSIONS OF CO_2 IN THE TWO MODELED SCENARIOS

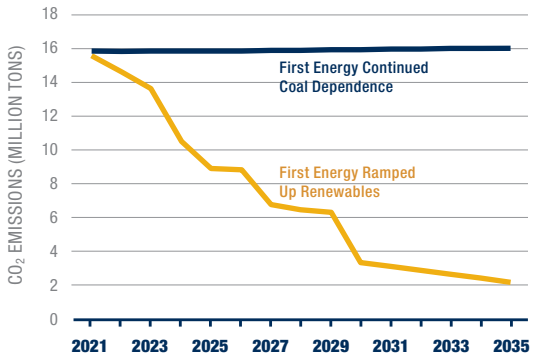
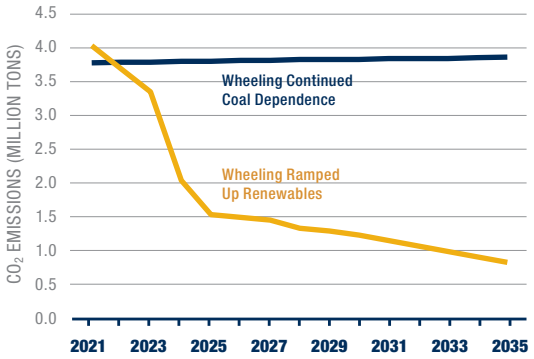


FIGURE 12. WHEELING POWER EMISSIONS OF CO_2 IN THE TWO MODELED SCENARIOS



3 ECONOMIC AND FINANCIAL MODELING RESULTS

3.1. REVENUE REQUIREMENTS

Customers in West Virginia save money with the Ramped Up Renewables scenario. The total revenue requirement for Ramped Up Renewables is consistently lower than Continued Coal Dependence, as can be seen in Figure 13 below. A utility revenue requirement is the amount of revenue that will need to be collected from ratepayers to pay for the capital and operating costs of each resource portfolio over the course of the study period, discounted to present dollars. Figure 13 shows the revenue requirements associated with both scenarios.

FIGURE 13. UTILITY REVENUE REQUIREMENT (NPV) IN $ MILLIONS

SCENARIO	CONTINUED COAL DEPENDENCE	RAMPED UP RENEWABLES
ApCo	17,281	16,945
First Energy	9,702	9,288
Wheeling	3,192	2,935

Revenue requirements are calculated as the sum of annual capital expenditures and production costs (i.e., fuel costs plus operation and maintenance) between 2021 and 2035, discounted to the present value using a Weighted Average Cost of Capital.[94] The capital component of the revenue requirement represents incremental capital costs only (i.e., those that are above the capital costs common to both scenarios) and therefore does not reflect proposed additions in recent IRP cases for APCo. The revenue requirement in both scenarios is made up predominantly of operating costs (i.e., fuel and operations and maintenance costs) associated with existing fossil resources. Capital investments in the Continued Coal Dependence scenario occur beginning in 2022, when EnCompass adds renewable resources to meet energy and capacity deficits. The Ramped Up Renewables scenario has a larger capital component because of the need to replace retiring coal units and meet the specified threshold of renewable energy generation (i.e., 30 percent by 2030 and 50 percent by 2035). Figure 14 through Figure 16 show the breakdown of utility revenue requirement by individual utility.

94 We assumed a Weighted Average Cost of Capital of 6.31 percent for the purposes of this analysis.

FIGURE 14. APCO REVENUE REQUIREMENT COMPARISON IN $ MILLIONS

SCENARIO	CONTINUED COAL DEPENDENCE	RAMPED UP RENEWABLES
Operating Cost	13,961	11,890
Capex	1,601	4,205
Carbon Cost	1,719	494
Energy Efficiency	-	355
Total	**17,281**	**16,945**

FIGURE 15. FIRSTENERGY REVENUE REQUIREMENT COMPARISON IN $ MILLIONS

SCENARIO	CONTINUED COAL DEPENDENCE	RAMPED UP RENEWABLES
Operating Cost	7,997	6,183
Capex	615	2,444
Carbon Cost	1,090	242
Energy Efficiency	-	419
Total	**9,702**	**9,288**

FIGURE 16. WHEELING POWER REVENUE REQUIREMENT COMPARISON IN $ MILLIONS

SCENARIO	CONTINUED COAL DEPENDENCE	RAMPED UP RENEWABLES
Operating Cost	2,029	2,079
Capex	903	662
Carbon Cost	260	80
Energy Efficiency	-	114
Total	**3,192**	**2,935**

3.2. ANALYSIS OF ENERGY COSTS TO CUSTOMERS

The lower revenue requirement for Ramped Up Renewables, presented in the previous section, means that customers in West Virginia should experience savings on their electricity bills. A simplified analysis of each utility's cost of energy divides the total going-forward revenue requirement (i.e., the cost of any capital additions, system production costs, and energy efficiency costs) by total sales.[95]

FIGURE 17. LEVELIZED COST OF ENERGY IN CONTINUED COAL DEPENDENCE VERSUS RAMPED UP RENEWABLES

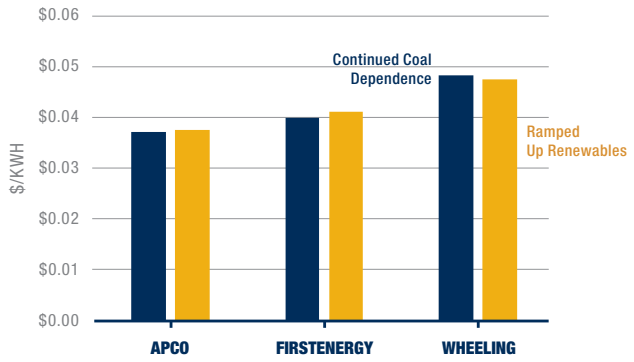
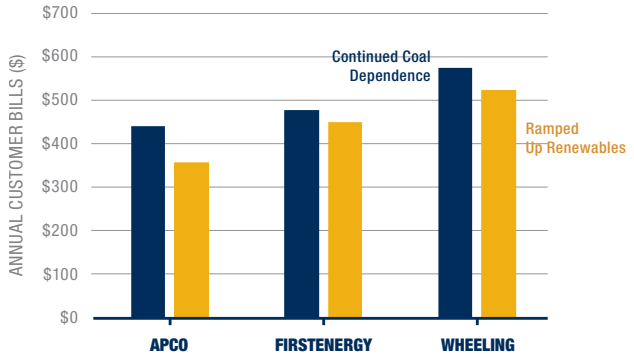


Figure 17 shows the levelized cost of energy over the 15-year analysis period for the three West Virginia utilities. For APCo and FirstEnergy, the levelized cost of energy in Ramped Up Renewables is minimally more expensive than in Continued Coal Dependence, at 0.04 cents more per kWh for APCo and 0.14 cents more per kWh for FirstEnergy. In Wheeling Power, the cost of energy in Ramped Up Renewables is 0.08 cents per kWh cheaper on a levelized basis than in Continued Coal Dependence.

FIGURE 18. LEVELIZED ANNUAL CUSTOMER BILLS IN CONTINUED COAL DEPENDENCE VERSUS RAMPED UP RENEWABLES



While the levelized cost of energy goes up slightly in two of the three utilities in our analysis, average annual customer bills are lower in Ramped Up Renewables for all utilities. Customers use less electricity as a result of energy efficiency measures, and even in those instances where the cost of energy is higher, the total customer spending is lower in Ramped Up Renewables, as shown in Figure 18.

95 This calculation should not be considered an analysis of customer rates for several reasons: (1) it does not differentiate between residential, commercial, and industrial customers; (2) it does not take into account the many different components of customer rates, e.g. transmission and distribution charges; and (3) it shows annual variability, whereas actual rates are set by state utility commissions at the time when utilities come in for a rate case adjustment.

The most dramatic customer savings comes in APCo's service territory, where Ramped Up Renewables results in a levelized savings of $84 per year. Savings in Wheeling Power's service territory is $50 per year on a levelized basis and $26 per year for FirstEnergy.

3.3. EMPLOYMENT IMPACTS

Synapse used the IMPLAN model to evaluate the impacts of Ramped Up Renewables on employment in West Virginia. IMPLAN is an industry-standard model that can be used to evaluate the impacts of changes in direct spending patterns on a state's economy.

For this analysis, spending impacts at the state level were determined by adding results for the three utilities in West Virginia. IMPLAN's framework enables us to assess not only impacts in directly affected industries, but also impacts on industries that serve as suppliers to directly impacted industries or that serve employees of directly and indirectly impacted industries. Synapse evaluated macroeconomic impacts resulting from changes in direct spending on the construction of each generation resource type, the operation of generation resources, decommissioning retired coal units, and the installation of energy efficiency measures. We also assessed impacts associated with changes in disposable income among households and businesses facing lower (or higher) energy costs in Ramped Up Renewables.

Comparing the employment impacts of Ramped Up Renewables relative to Continued Coal Dependence for the three five-year periods from 2021-2035, we find positive net employment impacts in the first two periods, and negative impacts in the final period. The EnCompass model builds fewer renewable resources in the final period, and this net negative impact could be reversed if additional renewable construction were to occur. Over the full IRP study period, our results indicate a net decrease in West Virginia employment equivalent to 130 full-time jobs, or 0.0002 percent.[96]

If wind resources built by the EnCompass model in Indiana and Illinois were instead constructed in West Virginia, the incremental benefits from Ramped Up Renewables would be much larger. During the 2021-2035 study period, the construction and operation of these new wind assets would yield additional employment equivalent to 1,267 full-time jobs.

96 Total civilian workforce in West Virginia is approximately 800,000. *See* Fed. Reserve Bank of St. Louis, Economic Research Div., *Civilian Labor Force for W. Va, Persons, 4-Quarter Moving Average, Quarterly, Not Seasonally Adjusted* (April 1, 2020), available at https://fred.stlouisfed.org/series/CIVLFWV.

4 HEALTH IMPACT MODELING RESULTS

4.1. HEALTH IMPACTS

Synapse used the CO-Benefits Risk Assessment (COBRA) tool to assess the avoided health impacts for residents of West Virginia and other states resulting from the change in emissions associated with Ramped Up Renewables. Developed for the U.S. Environmental Protection Agency (EPA) State and Local Energy and Environment Program, COBRA utilizes a reduced form air quality model to measure the impacts of emission change on air quality and translates them into health and monetary effects. For this analysis, Synapse used modeled emissions (SO_2, NO_X, & $PM_{2.5}$) from Continued Coal Dependence as a baseline and compared them to modeled emissions from Ramped Up Renewables.

COBRA can estimate a number of detailed health impacts, including adult mortality, infant mortality, non-fatal heart attacks, respiratory hospital admissions, cardiovascular-related hospital admissions, acute bronchitis, upper respiratory symptoms, lower respiratory symptoms, asthma exacerbations, asthma emergency room visits, minor restricted activity days, and work loss days due to illness. A subset of those specific health impacts is shown for select years in Table 1, with the numbers in the table representing the number of hospital visits and work loss days that could be avoided under Ramped Up Renewables.

TABLE 1. AVOIDED HEALTH IMPACTS OF RAMPED UP RENEWABLES

YEAR	HOSPITAL ADMITS, RESPIRATORY	HOSPITAL ADMITS, RESPIRATORY DIRECT	HOSPITAL ADMITS, ASTHMA	HOSPITAL ADMITS, LUNG DISEASE	HOSPITAL ADMITS, CARDIO	EMERGENCY ROOM VISITS, ASTHMA	WORK LOSS DAYS	$ WORK LOSS DAYS
2021	7	4	1	2	8	12	2,783	498,976
2025	30	21	3	6	37	51	10,926	1,958,611
2030	40	28	4	9	49	69	14,759	2,645,781
2035	44	31	4	9	54	76	16,268	2,916,331

In 2021 the difference in APCo's, FirstEnergy's, and Wheeling Power's electric system dispatch in Ramped Up Renewables avoids approximately seven respiratory-related hospital admits, eight cardiovascular-related hospital admits, and 12 asthma-related emergency room visits compared with Continued Coal Dependence. COBRA estimated significantly increased avoided health effects at the end of the modeling period in 2030 and 2035 compared to 2021. In 2035, Ramped Up Renewables avoids approximately 44 respiratory-related hospital admits, 54 cardiovascular-related hospital admits, and 76 asthma-related emergency room visits. These avoided health effects are

largely due to the decreased coal generation, which leads to an immediate decrease in emissions of air pollutants. Continued Coal Dependence keeps uneconomic coal units online and, when these units are not forced to generate, Ramped Up Renewables utilizes renewable resources in place of coal.

Similarly, in 2030 and 2035, Ramped Up Renewables avoids significantly higher mortality and non fatal heart attacks when compared with Continued Coal Dependence, as can be seen in Table 2.

TABLE 2. AVOIDED MORTALITY AND HEART ATTACKS UNDER RAMPED UP RENEWABLES

YEAR	MORTALITY, LOW	MORTALITY, HIGH	INFANT MORTALITY	NON FATAL HEART ATTACKS, LOW	NON FATAL HEART ATTACKS, HIGH
2021	23	52	0.04	3	27
2025	98	221	0.15	12	116
2030	132	299	0.20	17	156
2035	146	330	0.22	19	172

In addition to physical health effects and the costs of associated medical treatment, illnesses related to air pollution impose other costs on society, which include lost productivity and wages if a person misses work or school and restrictions on outdoor activity when air quality is poor. Table 3 shows low and high estimates of the monetized value of these total health benefits. These numbers place an economic value on all of the avoided health impacts modeled in COBRA, plus the value of minor restricted activity days and work loss days.

TABLE 3. MONETARY BENEFITS OF ALL AVOIDED HEALTH IMPACTS UNDER RAMPED UP RENEWABLES

YEAR		TOTAL HEALTH BENEFITS, LOW	TOTAL HEALTH BENEFITS, HIGH
2021	*Total*	$221,304,464	$500,576,556
	West Virginia	$16,216,244	$36,725,923
2025	*Total*	$987,253,436	$2,229,954,410
	West Virginia	$53,300,118	$120,486,699
2030	*Total*	$1,332,054,561	$3,008,659,771
	West Virginia	$69,058,118	$156,113,949
2035	*Total*	$1,469,407,937	$3,318,851,705
	West Virginia	$77,332,224	$174,809,135

The cumulative health benefits of the Ramped Up Renewables scenario over 15 years is likely to be at least $500 million and may exceed $1 billion for West Virginia residents. For the region, total benefits are likely to exceed $10 billion.

ATTACHMENT A

MODELING PARAMETERS

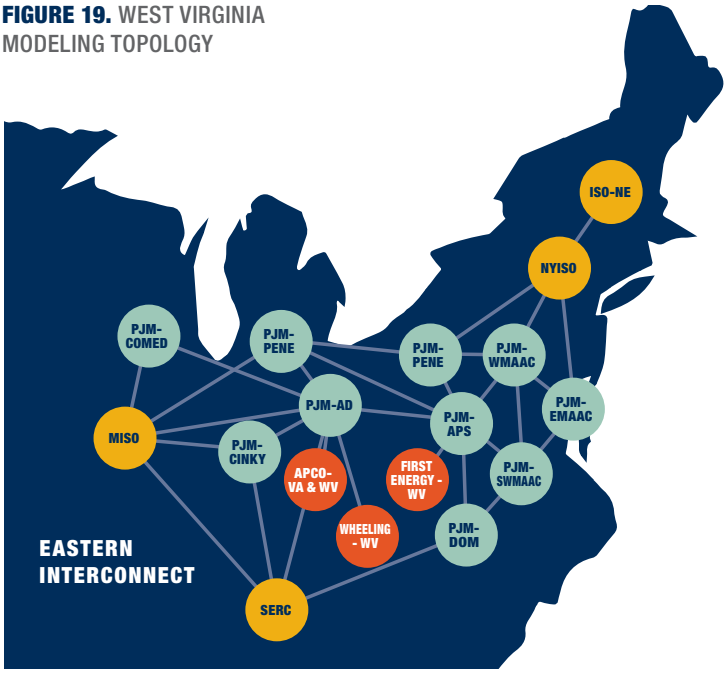
Synapse used EnCompass to model resource choice impacts in West Virginia. Developed by Anchor Power Solutions, EnCompass is a single, fully integrated power system platform that provides an enterprise solution for utility-scale generation planning and operations analysis. EnCompass is an optimization model that covers all facets of power system planning, including:

- **Short-term scheduling, including detailed unit commitment and economic dispatch, with modeling of load shaping and shifting capabilities;**
- **Mid-term energy budgeting analysis, including maintenance scheduling and risk analysis;**
- **Long-term integrated resource planning, including capital project optimization, economic generating unit retirements, and environmental compliance; and**
- **Market price forecasting for energy, ancillary services, capacity, and environmental programs.**

Synapse used the EnCompass National Database created by Horizons Energy to model the West Virginia utilities' service territories. Horizons Energy has benchmarked dispatch and prices resulting from its comprehensive dataset to actual, historical data across all modeling zones. More information on EnCompass and the Horizons dataset is available at www.anchor-power.com.

TOPOLOGY AND TRANSMISSION

FIGURE 19. WEST VIRGINIA MODELING TOPOLOGY



Synapse modeled the entire PJM region with full unit-level operational granularity. Additionally, we modeled external contract regions representing the NYISO, MISO, SERC, and ISO-NE regions. We relied on transmission assumptions from the EnCompass National Database, displayed in Figure 19 to the left. Energy transfers from external regions are priced at recent historical energy prices and escalated throughout the period.

PEAK LOAD AND ANNUAL ENERGY

Synapse relied on annual energy and total system peak load for summer and winter as defined in the respective IRP and EIA 861 sales data.

FUEL PRICES

FIGURE 20. COAL PRICE FORECAST

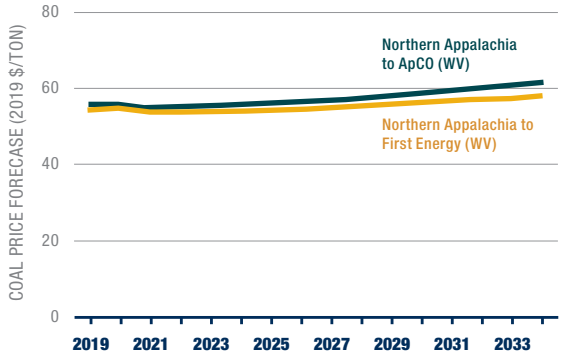


FIGURE 21. PRICE ON EMISSIONS OF CARBON DIOXIDE

YEAR	CARBON PRICE (NOM$/TON)	YEAR	CARBON PRICE (NOM$/TON)
2021	$0.00	2029	$15.75
2022	$0.00	2030	$16.54
2023	$0.00	2031	$17.36
2024	$0.00	2032	$18.23
2025	$0.00	2033	$19.14
2026	$0.00	2034	$20.10
2027	$0.00	2035	$21.11
2028	$15.00		

For gas prices, Synapse relies on Dominion south gas prices in APCo based on its latest IRP for Virginia in 2019.

Synapse relies on the EnCompass National Database (NDB) for unit-level coal price forecasts. For the PJM region, the NDB relies on 21 discrete forecasts, and projects costs for coal sourced from the Northern Appalachia, Central Appalachia, Southern Powder River, International, and Illinois Basin regions. Figure 20 shows two coal price forecasts—coal deliveries from Northern Appalachia to the modeled territories.

PROGRAMS

A price on emissions of CO_2 was not included as part of the model optimization. Total cost of CO_2 emissions was calculated for each case using the values shown in Figure 21, which were taken from the Southwestern Electric Power Company (SWEPCO) IRP 2018.

ENERGY EFFICIENCY COSTS

While costs for energy efficiency may vary based on geography, sector, size of program, maturity of the program, etc., the energy efficiency cost assumptions for this analysis are based on a 2018 work published by the Lawrence Berkeley National Laboratory which concludes that the levelized cost of saved energy for utilities is 2.5 cents per kilowatt hour (kWh).[97]

97 I. Hoffman et al, *The Cost of Saving Elec. Through Energy Efficiency Programs Funded by Util. Customers: 2009-2015,* Lawrence Berkeley Nat'l Lab. (June 2018).