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FACT SHEET

HOW VIRGINIA CAN MEET ITS CLEAN POWER PLAN TARGETS

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WHAT DOES THE CLEAN POWER PLAN MEAN FOR VIRGINIA?

In August 2015, the U.S. Environmental Protection Agency (EPA) finalized the Clean Power Plan (CPP), the first-ever carbon pollution standards for existing power plants (Box 1). The CPP builds on progress already under way to move the country toward a cleaner electricity system, including rapidly falling prices of renewables and increased deployment of money-saving energy efficiency measures. The plan enables states to use a wide range of options to meet their standards, such as existing clean energy policies and power plants (the focus of this analysis), other tools to cut electricity use and increase the use of renewables, and broader initiatives such as participation in a cap-and-trade program or use of a carbon tax (Box 2).

Because of the flexibility of the CPP framework and planned changes to Virginia's power mix, Virginia is well-positioned to meet—and beat—the carbon pollution standards for the state's power plants. The commonwealth's power sector is already decarbonizing.[1] Its aging coal fleet is being phased out, new natural gas plants are being installed, and programs are under way to increase efficiency and the use of renewable energy sources. This fact sheet examines how Virginia can make further progress toward meeting the standards for its plants under the CPP while minimizing compliance costs, ensuring reliability, and harnessing economic opportunities.

WHAT DOES THE CLEAN POWER PLAN REQUIRE FOR VIRGINIA'S POWER PLANTS?

Each state has the flexibility to use one of three targets provided in the Clean Power Plan, either (1) an emission rate standard, which measures the carbon intensity of the state's existing fossil electricity generation; (2) a mass-based standard, which measures the absolute level of carbon dioxide (CO_2) emissions allowed by the state's existing power plants; or (3) a mass-based target for new and existing power plants (i.e., new source complement).

Virginia can choose one of the following three targets:

- **Emission rate standard:** 934 pounds per megawatt-hour (lbs./MWh) by 2030, a reduction of 32 percent below power plants' 2012 emission rate of 1,366 lbs./MWh.
- **Mass-based standard:** 27.4 million short tons of CO_2, which is about 23 percent lower than the state's CO_2 emissions in 2012.
- **Mass-based standard for new and existing sources:** 27.7 million short tons of CO_2 in 2030, which is about 23 percent lower than the state's CO_2 emissions in 2012.

The percent reductions are calculated using an adjusted 2012 baseline that includes the CO_2 emissions and generation from fossil plants that were under construction as of January 8, 2014, and are affected by the Clean Power Plan, consistent with EPA's methodology.

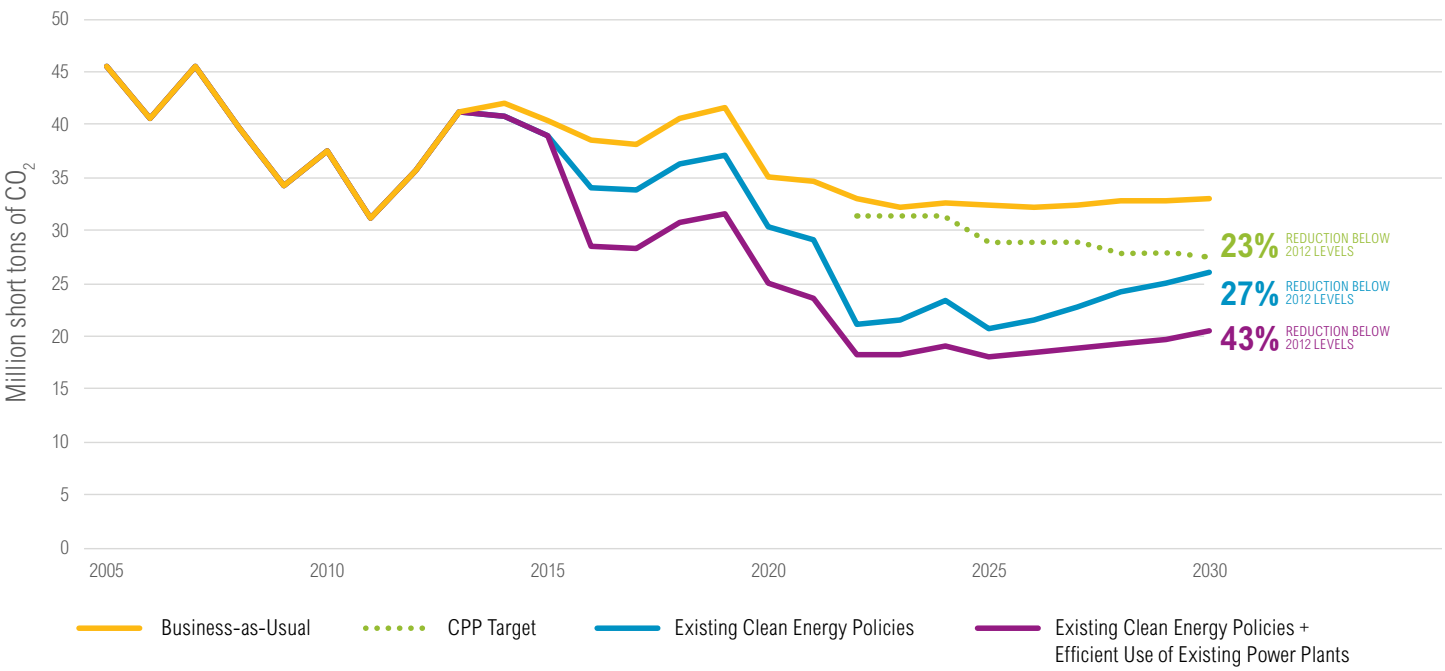
HOW VIRGINIA'S POWER PLANTS CAN MEET—OR EXCEED—THE CLEAN POWER PLAN REQUIREMENTS

Virginia's power plants have already reduced their CO_2 emissions by 22 percent between 2005 and 2012,[2] due in large part to using more natural gas and less coal to generate electricity, as well as lower overall electricity generation. This has resulted in a 30 percent decrease in the state's compliance fossil emission rate—a measure of the carbon-intensity of its fossil-fuel-fired electricity generation—calculated based on the methods in EPA's Clean Power Plan. However, this downward trend in CO_2 emissions is not expected to continue over the short term.[3] Generation of electricity from the existing power fleet is expected to increase by 11 percent between 2012 and 2019, due partly to Dominion Power's plans to import less electricity. Much of this new generation will be provided by two new natural gas combined cycle (NGCC) units that will be coming online by the end of 2016,[4] in addition to the ramping up of the existing coal fleet. As a result, emissions are expected to increase to 16 percent above 2012 levels by 2020.

However, over the longer term, more renewable generation is expected to come online. Excluding hydropower, renewable generation is projected to increase from 1 TWh in 2012 to almost 10 TWh in 2030, assuming that Appalachian Power (APCo) locates half of its projected renewable generation in Virginia. Over the same time period, coal-fired generation is projected to decrease, so that by 2030, CO_2 emissions from Virginia's existing fossil fleet is reduced to 8 percent below 2012 levels (see Figure 1). All of these planned actions, which are reflected in our business-as-usual projections, would achieve almost one-third of the total reductions the state needs between 2012 and 2030 in order to meet its mass-based target.

These actions would also reduce the state's fossil CO_2 emissions rate by 18 percent between 2012 and 2030. However, the state may end up emitting more CO_2 emissions than the estimate in our business-as-usual projections, since Dominion is planning to build its natural-gas-fired Greensville County Power Station in 2019, which would not fall under the CPP if Virginia decides to comply with EPA's existing source-only standard. **Adopting EPA's new source complement standard (see Box 2) would further incentivize zero-carbon generation sources and ensure that future CO_2 emissions from the state's power sector do not continue to increase.**

Figure 1 | **Existing Power Plant Emission Pathways for Virginia**



Note: This figure depicts the Clean Power Plan's interim and 2030 mass-based targets for Virginia's affected power plants (CPP target). The Existing Clean Energy Policies and Existing Clean Energy Policies + Efficient Use of Existing Power Plants pathways show emissions from affected plants after implementing the state's clean energy policies (efficiency and renewable energy goals) and making better use of the state's existing power plants (increasing generation at the existing NGCC fleet, which includes the two NGCC plants that were under construction as of January 2014). These pathways do not account for potential credits that Virginia could generate by taking early action under the Clean Energy Incentive Program.

CO_2 REDUCTIONS FROM EXISTING CLEAN ENERGY GOALS

Virginia's existing fossil plants can achieve almost one-third of the reductions required between 2012 and 2030 in order to meet its mass-based target with its planned coal retirements and planned investment in clean energy. Virginia can close the gap that remains, and even surpass its mass-based target, if the state achieves its clean energy goals.

Specifically, by achieving its voluntary goals to improve efficiency and use of renewables, Virginia's existing plants can decrease their mass-based CO_2 emissions to 27 percent below 2012 levels in 2030, surpassing its mass-based target. In doing so, Virginia's plants would reduce their average emission rate by 25 percent below its 2012 emission rate to 1,024 lbs. per MWh in 2030, falling short of the state's rate-based target of 934 lbs. per MWh.

IMPROVING ENERGY EFFICIENCY

Virginia currently has a voluntary goal to reduce electricity consumption by 10 percent below 2006 levels of consumption by 2022.[5] However, electric generation in the state is actually projected to increase by 42 percent over this time period, due mostly to Dominion Power's expectations to decrease its electricity imports and increase its in-state generation. Fortunately, studies have identified a large potential for energy efficiency to be tapped to curb this demand growth, while also lowering the household energy bills that are currently among the ten highest in the nation.[6] In addition to the reductions captured in Virginia's business-as-usual projections, adopting measures and policies that help achieve its efficiency goal can get the state almost 80 percent of the reductions required between 2012 and 2030 in order to meet its mass-based emissions standard under the Clean Power Plan.[7]

Box 1 | Overview of EPA's Final Clean Power Plan

The power sector is the leading source of carbon dioxide (CO_2) emissions in the United States, but also offers some of the most cost-effective opportunities to reduce those emissions. Power sector emissions at the national level decreased by 16 percent between 2005 and 2012 due to the recession, increasing penetration of renewable energy, increasing energy efficiency, and the low price of natural gas. Without new policies like the Clean Power Plan (CPP), though, current projections show that emissions will slowly rise or hold steady through 2030 to reach 10–17 percent below 2005 levels.*

On August 3, 2015, EPA finalized standards for existing power plants that will help drive additional CO_2 emission reductions by 2030. States have the option to comply with either rate-based (lbs. CO_2 per megawatt-hour) or mass-based (short tons of CO_2) standards. EPA developed these state-specific standards by taking into account each state's existing fossil fleet along with an estimate of the potential to increase the existing coal fleet's efficiency, ramping down coal generation by increasing utilization of the existing natural gas combined cycle fleet, and developing more renewable energy resources.

The Clean Power Plan makes use of the flexibility allowed by the Clean Air Act so that states can take advantage of several different measures to lower the carbon intensity of their power generation mix—such as fuel switching, dispatch of existing low-carbon power plants, increased generation by renewable sources, and energy efficiency. EPA also is providing states with several implementation plan options, including the option to get credit for early action, which we discuss in more detail in Box 2. States have until September 6, 2016 to submit either a final implementation plan or an initial submission with an extension request. All state plans should be completed by 2018 and compliance will begin in 2022. EPA will issue a federal implementation plan for states that do not submit their own plans. EPA proposed a federal plan in August 2015 and is expected to finalize the plan in the summer of 2016.

Note: * While CO_2 emissions from the power sector have already fallen 16 percent since 2005 (relative to 2012 levels), the U.S. Energy Information Administration's *Annual Energy Outlook 2015* projects that power sector emissions will slowly increase between 2012 and 2030 so that CO_2 emissions reach approximately 10 percent below 2005 levels. On the other hand, EPA's baseline projections for its modeling of the Clean Power Plan, which includes lower cost estimates for renewable technologies, estimate that power sector emissions will reach 17 percent below 2005 levels by 2030. Specifically, EPA's projections estimate less coal-fired generation and more natural gas and renewable generation in 2030 than EIA's projections.

INCREASING USE OF RENEWABLE ENERGY

Virginia's investor-owned utilities may participate in the state's voluntary renewable portfolio standard program. The program has a goal that by 2025, 15 percent of electricity sold (relative to 2007 sales) is from renewable sources.[8] Virginia is projected to generate roughly 8 percent of its electricity using renewable sources in 2025 (relative to 2007 sales),[9] but the state has considerable untapped wind and solar potential.[10] Taking into account (a) the reductions already captured in our business-as-usual projections, and (b) achieving the state's energy efficiency goal, ensuring that Virginia's investor-owned utilities generate 15 percent of their electricity from renewable sources (relative to 2007 sales) by 2025 and beyond would help the state exceed the reductions required to meet its mass-based emission standard by 18 percent.[11]

CO_2 REDUCTION OPPORTUNITIES USING AVAILABLE POWER PLANTS

In addition to its clean energy goals, making better use of the state's existing power plants, like increasing generation at its existing natural gas combined cycle fleet, would help Virginia's existing fossil plants to overcomply with its mass-based standard by reducing existing power plant emissions 43 percent below 2012 levels by 2030 (Figure 1). If Virginia were to choose to use the rate-based target, these actions would reduce the average emission rate of Virginia's existing fossil fleet by 37 percent below its 2012 emission rate to 854 lbs. per MWh in 2030.[12] Because the CPP simplifies cross-state trading of carbon allowances, Virginia could generate revenue by going beyond the required reductions and sell excess allowances to other states. Virginia also could generate additional allowances by taking advantage of EPA's Clean Energy Incentive Program, which rewards early action in renewable energy and energy efficiency in low-income communities.

Box 2 | Clean Power Plan Compliance Options

The Clean Power Plan offers states significant flexibility. As states develop their implementation plans, they will need to make a number of decisions that will affect how they comply. Key considerations include:

- **TYPE OF TARGET**
  States can choose either a rate-based target (in lbs. CO_2/MWh) or a mass-based target (in short tons of CO_2). States using a rate-based target can adopt separate standards for coal and combined cycle natural gas units, a weighted average for all affected units, or equivalent standards that apply to individual units or groups of units. States using a mass-based target can use EPA's standard for existing units only, or for existing and new units collectively (known as a new source complement).

  Since mass-based plans will rely on reported power plant emissions, complementary actions to improve energy efficiency and increase renewable generation do not need to be quantified in the state plans. Rate-based plans require an explicit accounting of actions used to adjust the emission rate from affected units, as well as evaluation, measurement, and verification.

- **TYPE OF STATE PLAN**
  The CPP includes two types of state plans. Under an "emission standards" plan, states place mass- or rate-based emissions requirements directly on affected units, which are then allowed to reduce their emissions or rate directly or by using credits generated by fuel-switching, renewable energy, energy efficiency, or other approved measures. States that adopt a mass-based target can opt for a "state measures" plan. With this type of plan, states can use a portfolio of state-enforced measures that can apply both to affected units and other entities (for example, demand-side efficiency, renewable portfolio standards, cap-and-trade programs). Under this approach, states could also implement a carbon tax for compliance. This approach must include emission standards for affected power plants in case the portfolio approach does not achieve the required reductions.*

- **INDIVIDUAL OR MULTISTATE COMPLIANCE**
  States can choose to comply individually or as part of a multistate plan with an aggregated target. States also can coordinate with other states while retaining an individual state goal. Joining a regional cap-and-trade program may be the most cost-effective option for some states, lowering compliance costs while ensuring reliability.[a] Studies in the Southwest Power Pool, PJM, and MISO regions have found that regional compliance would be the most cost-effective option.[b]

  The Regional Greenhouse Gas Initiative illustrates how a multistate trading approach can help reduce emissions while driving investments in renewable energy and energy efficiency and saving money for electricity customers. Over the first six years of the program, investments from auction proceeds have generated nearly $3 billion in economic value-added to the region and created over 28,000 job-years of employment.[c]

- **TRADING:** States don't need to join a cap-and-trade program or formally coordinate with other states to trade. EPA allows states to trade emission rate credits (rate-based target) or emission allowances (mass-based) regardless of their implementation plan type as long as states meet "trading ready" criteria provided in the rule.** Once trading-ready state plans are approved, states can begin trading right away without additional requirements or approval from EPA.

- **EARLY ACTION:** EPA is offering a Clean Energy Incentive Program to reward early investments in energy efficiency projects that benefit low-income communities and renewable energy. States can earn additional credits from EPA by implementing eligible projects in 2020 and 2021.

Notes: * According to the final rule, a state measures plan "must also include a contingent backstop of federally enforceable emission standards for affected EGUs that fully meet the emission guidelines and that would be triggered if the plan failed to achieve the required emission reductions on schedule." ** These criteria include use of an EPA-approved (or EPA-administered) emission and allowance tracking system (mass-based) and provisions for issuing, tracking, and submitting emission rate credits (rate-based). Section VIII of the final rule provides more guidance (http://www.epa.gov/airquality/cpp/cpp-final-rule.pdf).

Sources:

a. Susan Tierney and Paul Hubbard. Analysis Group, May 2015. "Carbon Control and Competitive Wholesale Electricity Markets: Compliance Paths for Efficient Market Outcomes." Accessible at: <http://www.analysisgroup.com/uploadedfiles/content/insights/publishing/clean_power_plan_markets_may_2015_final.pdf>.
b. MISO. 2015. "Clean Power Plan Analysis Update." ERSC Meeting. Accessible at: <https://www.misoenergy.org/Library/Repository/Meeting%20Material/Stakeholder/ICT%20Materials/ERSC/2015/20150512/20150512%20ERSC%20Item%2006b%20Clean%20Power%20Plan%20Update.pdf>. PJM. 2015. "PJM Interconnection Economic Analysis of the EPA Clean Power Plan Proposal." Accessible at: <http://www.pjm.com/~/media/4CDA71CBEC864593BC11E7F81241E019.ashx>. Southwest Power Pool. 2015. "SPP Clean Power Plan Compliance Assessment- State by State." SPP Engineering. Accessible at: <http://www.spp.org/publications/SPP_State_by_State_Compliance_Assessment_Report_20150727.pdf>.
c. Analysis Group. 2015. "The Economic Impacts of the Regional Greenhouse Gas Initiative on Nine Northeast and Mid-Atlantic States." Accessible at: <http://www.analysisgroup.com/uploadedfiles/content/insights/publishing/analysis_group_rggi_report_july_2015.pdf>. Acadia Center. 2015. "The Regional Greenhouse Gas Initiative: A Model Program for the Power Sector." Accessible at: <http://acadiacenter.org/wp-content/uploads/2015/07/RGGI-Emissions-Trends-Report_Final.pdf>.

INCREASING THE USE OF EXISTING NATURAL GAS PLANTS

Virginia's most efficient natural gas plants—combined cycle (NGCC) units—generated less electricity than they were capable of producing in 2012. By running existing NGCC plants (and those already under construction as of January 2014) at 75 percent, in addition to achieving the state's clean energy goals, Virginia could exceed the reductions required to meet the mass-based standard by 84 percent.[13]

HOW VIRGINIA CAN MAXIMIZE THE ECONOMIC BENEFITS OF THE CLEAN POWER PLAN

As we have shown, Virginia's current plans for the electricity sector will achieve almost one-third of the reductions required between 2012 and 2030 in order to meet its mass-based target. Looking forward, Virginia can develop an implementation plan that maximizes the economic benefits to the state and achieves emissions reductions cost-effectively. Such a plan could include:

- **Adopting a market-based carbon pricing program:** A carbon pricing program—in the form of either a cap-and-trade program or a carbon fee—has major economic advantages over alternative implementation approaches:

  1. A carbon price encourages the most cost-effective emissions reductions without favoring any particular technology. A study of air pollution regulations found that market-based approaches have ranged from 1.1 times to 22 times more cost-effective than non-market approaches to regulation.[14]
  2. Revenues from allowance auctions or a carbon fee can be used to accomplish other policy objectives such as reducing the tax burden on Virginians or making productive public investments. A carbon price of $10 per ton for the power plant emissions allowed under Virginia's mass-based target would provide average annual revenues of over $290 million.[15] This revenue could be used to provide assistance to those who may be adversely affected by the carbon price, such as low-income households and coal industry workers; make further investments in renewable energy and energy efficiency; or offset other taxes. The Regional Greenhouse Gas Initiative illustrates how investment of auction revenue can benefit the local economy—investments of nearly $2 billion in auction proceeds into bill assistance, energy efficiency, renewable energy, and other uses from 2009-2014 generated nearly $3 billion in economic value added across the nine participating states.[16]
  3. The CPP encourages states to take advantage of interstate trading opportunities without needing to formally join a regional program. A recent study by PJM that examined the proposed Clean Power Plan found that compliance would be much cheaper if PJM states established a market-based allowance trading program compared to each state complying on its own.[17] Taking advantage of interstate trading would also enable Virginia to sell surplus allowances and generate revenue from out-of-state sources if it surpasses its CPP targets. Assuming an allowance price of $10 per ton, over $100 million in revenues could flow into the commonwealth per year on average between 2022–30 if it achieved its clean energy goals and increased its use of the state's existing natural gas fleet and sold the credits on interstate markets. (This does not include consideration of any credits that might be generated through the Clean Energy Incentive Program prior to 2022.) PJM's analysis of the proposed Clean Power Plan found that Virginia could receive $186 to $498 million of revenue in 2029.[18]
  4. Carbon pricing provides financial incentives for regulated entities to reduce their emissions beyond the target, which encourages the adoption and diffusion of low-carbon energy technologies. Such technological advancements can lower overall compliance costs and boost economic growth.

- **Investing in energy efficiency.** Virginia's residential electric bills are among the ten highest in the nation.[19] By reducing electricity demand, improvements in energy efficiency reduce the need for investments in electricity supply, which frees up capital to invest in other productive areas across the economy. If the energy efficiency programs are less expensive than electricity generation—as the empirical evidence indicates many of them are[20]—electricity prices should fall, leaving Virginians with more income to spend, save, or invest.

The investments needed to move toward a low-carbon future will strengthen Virginia's economy over the long-term. While these investments are likely to involve short-run economic costs—including somewhat higher electricity rates and fewer investment dollars available for alternative opportunities in the electricity sector or across the economy—they will pay off over time. Virginians will spend far less of their income on electricity thanks to improvements in efficiency and the low operating costs of renewable energy.[21] And less reliance on coal will enable more in-state investment—Virginia pays about $500 million per year to other states to import coal.[22]

In a transition to a low-carbon power sector, jobs will be gained in the clean energy industry and will decline in high-carbon industries, like coal, accelerating trends already under way. The clean energy industry creates jobs in manufacturing, construction, home maintenance, and other sectors—in 2014, the wind and solar industries alone employed 2,800 people in Virginia.[23] State and federal governments should help manage the transition to a lower-carbon economy by offering job training or other programs to ensure that opportunities are available for all workers.

Strong implementation of the CPP is a critical component of the U.S. commitment to a global climate agreement that can help reduce global emissions and combat climate change. Failure to avoid the worst effects of climate change could result in high costs for Virginia's residents. For example, the Norfolk-Virginia Beach Metropolitan Area ranks 10th in the world in value of assets exposed to an increase in flooding from sea-level rise.[24] According to a Risky Business study, continued warming could include the following effects on Virginia's economy:[25]

- A rise in sea level of 1.1 to 1.7 feet by 2050 and 2.5 to 4.4 feet by 2100
- As much as $306 million in property to be below sea level by 2050
- Storm surges on the Virginia shoreline costing $522 million in damages by 2050
- Higher statewide energy expenditures of $815 million each year by 2050
- Heat-related labor productivity declines costing up to $1.1 billion annually by 2050.

In addition to helping combat climate change, lowering the carbon intensity of the power sector in Virginia will lead to reductions in harmful local air pollutants. According to EPA, exposure to pollutants like particulate matter, nitrogen oxides, and sulfur dioxide can lead to respiratory issues or heart and lung diseases.[26] Reducing these emissions will make for a healthier work force that spends less on medical bills.

With the state's clean energy goals, CO_2 emissions from Virginia's existing power plants are on a pathway to decrease with or without the Clean Power Plan. Virginia can now use this rule as an opportunity to maximize economic benefits from continuing to curb emissions and thus meeting or exceeding its Clean Power Plan targets.

THE CLEAN POWER PLAN WILL MAINTAIN ELECTRIC GRID RELIABILITY

The Clean Power Plan provides flexibility aimed at ensuring the continued reliability of the nation's power grid.[27] Under the final CPP, states can choose from a wide variety of compliance options that are best suited to that state's existing resources and policies. While EPA is offering states incentives to invest in renewable energy and energy efficiency early, they also have given states additional time to complete and implement their plans by changing the compliance start date from 2020 to 2022. In addition, the Clean Power Plan is requiring each state to consider reliability issues as they develop their implementation plans, while also providing a mechanism for states to revise their plans if significant unplanned reliability issues arise. EPA also created a reliability safety valve that allows a power plant to temporarily exceed its targets during unexpected events or emergencies that raise reliability concerns. EPA consulted closely with the Department of Energy and the Federal Energy Regulatory Commission in developing the CPP's reliability provisions. These agencies will continue to work together to monitor CPP implementation and help resolve any reliability concerns that arise.

The U.S. power sector also has shown it has the ability to reliably deliver electricity to homes and businesses despite changes in electricity mix and demand. EPA's environmental regulations under the Clean Air Act, such as the Acid Rain Program or Mercury and Air Toxics Standards, have never caused blackouts. This is because EPA granted flexibility to power plants in the past—just like it is doing under the Clean Power Plan—and because state regula-

tors have standard reliability practices that have been used for decades to address reliability issues if and when they arise.[28] Analyses of the proposed Clean Power Plan have shown that compliance is unlikely to affect reliability because of these standard practices and the flexibility inherent in the rule.[29] In addition, several studies have found that the flexibility of the current grid would allow for renewable penetration levels exceeding those required by current state targets. These studies have shown that proven technologies and practices can reduce the cost of operating generation portfolios with high variable renewable energy levels and enable reliable grid operation with more than 50 percent renewable penetration.[30] PJM, the regional grid operator for Virginia, found that it could handle 30 percent variable renewable penetration with no reliability issues as long as adequate additions in transmission and regulation reserves were made.[31]

OPPORTUNITIES IN DETAIL

Below we describe Virginia's opportunities to comply with the Clean Power Plan in more detail, including increasing (1) energy efficiency, (2) renewable energy, and (3) use of the existing natural gas fleet.

1. ENERGY EFFICIENCY OPPORTUNITIES

Virginia currently has a voluntary goal to reduce electricity consumption by 10 percent below 2006 levels by 2022 (this translates to about 6 TWh of electricity generation savings).[32] The state is looking to see if this goal could be achieved earlier; the state's Board on Energy Efficiency (established by the 2014 Energy Plan) is developing a strategic plan to achieve the voluntary goal of reducing energy consumption by 10 percent below 2006 levels by 2020.[33] However, electric generation in the state is actually projected to increase by 34 percent over this time period (2012–20).This is due partly to Dominion Power's expectation of higher demand (projected to grow about 12 percent), as well as its plans to meet more of its demand through in-state generation as opposed to imports from other states (power purchases are projected to decrease about 50 percent).[34,35] APCo also expects to reduce its power purchases going forward.[36] The Advanced Energy Economy Institute and Virginia Advanced Energy Industries Coalition found that Virginia could create around 6,800 new jobs (net) per year on average between 2012 and 2030 by reducing its electricity imports and investing in clean in-state energy sources instead.[37]

Historically, the state has done little to promote energy efficiency. In 2014, the American Council for an Energy-Efficient Economy (ACEEE) gave Virginia its lowest score (0 out of 20) for utility and public benefits programs and policies.[38] Unsurprisingly, Virginia's residential electric bills are among the ten highest in the nation.[39] This means that a great deal of low-hanging opportunities still remain that the state could take advantage of to curb this demand growth. If the state ramps up its investment in energy efficiency in order to meet its efficiency goal, total in-state generation would decrease by 7 percent in 2022 below projected levels.[40] Some of this efficiency (about 2 percent) is already captured in our business-as-usual projections since Dominion has started to implement new efficiency programs like residential and commercial lighting programs and a nonresidential energy audit program. Amendments to Virginia energy legislation in 2015 require Dominion and APCo to fund programs that improve the household energy efficiency of low-income, elderly, and disabled individuals[41] and improve the financing of clean energy projects.[42] Actions like these put Virginia in a good position to take advantage of EPA's Clean Energy Incentive Program, which allows states to earn extra carbon allowances by deploying efficiency projects in low-income communities in 2020 and 2021. Virginia could take many other actions to scale up its efficiency savings, including increasing its use of combined heat and power at power plants,[43] adjusting its cost-effectiveness tests at the SCC to eliminate overreliance on the outdated rate impact measure test, increasing its spending cap on efficiency programs, and establishing incentives for utilities to pursue energy efficiency (which 30 states already do), among other measures.[44]

A number of different analyses have confirmed that a high level of electricity savings is technologically achievable. According to Georgia Tech and the Nicholas Institute, a 7.5 percent reduction in energy consumption (including savings in both electricity and natural gas consumption) by 2020 would lead to $1.8 billion in electricity savings for Virginians in that year, with the average household saving $325 on its annual energy bill.[45] A separate comprehensive study by ACEEE similarly found that Virginia could achieve 19 percent electricity savings in 2025 with annual energy bill savings of $2.2 billion.[46] Moreover, a recent study by Synapse found that using energy efficiency as a compliance option under the proposed Clean Power Plan (by ramping up energy efficiency savings to 2 percent per year starting in 2020) could net Virginia residents $264

on their annual household energy bills in 2030.[47] The state's own 2014 Energy Plan noted that robust energy efficiency policies in Virginia could increase the gross state domestic product by $286 million and increase employment by 38,000 jobs by 2030.[48] Scaling up the state's investment in energy efficiency would also allow Virginia's utilities to avoid spending money on building new natural gas plants in the future. The results of these studies illustrate that energy efficiency is perhaps Virginia's single greatest economic opportunity under the Clean Power Plan.

2. RENEWABLE ENERGY OPPORTUNITIES

Virginia's investor-owned utilities may participate in the state's voluntary renewable portfolio standard program, which has a goal that by 2025, 15 percent of electricity sold (relative to 2007 sales) is from renewable sources.[49] This voluntary goal currently allows participating utilities to purchase renewable energy credits for compliance purposes (including credits generated from qualifying research and development) and to receive double credit for solar, onshore wind, and animal waste fuel sources, and triple credit for offshore wind sources.

Renewable generation comprised only 3 percent of Virginia's total electric generation in 2013.[50] About half of the state's renewable generation comes from hydro sources, with the remainder coming mostly from wood or other biomass-based sources. Virtually none of Virginia's electricity currently comes from two of the nation's fastest-growing sources of electricity, solar and wind. Virginia has vast potential to add more solar and wind energy—several of its neighbors have some installed wind capacity (while Virginia had none as of 2013).[51] North Carolina has over 1 GW of installed solar PV, while Virginia has only 15 MW.[52] Looking ahead, the state is aiming to make better use of its wind and solar resources. Apex is planning to build two wind farms by 2018,[53] Dominion is planning to build 400 megawatts of solar within the state by 2020,[54] and Amazon is building an 80 MW solar farm that should start producing power as early as October 2016. Virginia Governor Terry McAuliffe commented, "Amazon's new solar project will create good jobs on the Eastern Shore and generate more clean, renewable energy to fuel the new Virginia economy."[55] This project illustrates the potential economic benefits Virginia can foster by making it easier for companies to develop and gain access to clean energy.

Increasing its use of wind, solar, and other renewable sources could also lead to cost savings for customers. For example, analysis of the PJM region found that increased investment in renewable energy in the region would cut system-wide costs, resulting in a net benefit (after taking into account investment costs for new wind and natural gas generation and transmission requirements) of up to $6.9 billion per year in PJM by 2026—or $113 per year per person.[56] Virginia recently enacted several laws to help support it's solar energy development, including the declaration that solar energy is in the state's public interest,[57] establishment of a solar development authority,[58] and allowing owners of grid-connected solar energy to be compensated for the clean energy they produce (known as net metering).[59] Virginia can take additional action going forward, such as allowing for community net metering or setting an enforceable renewable energy target.

In our analysis, we assume that the state's investor-owned utilities generate 15 percent of their electricity from CPP-eligible renewable sources by 2025 (based on 2007 sales, without using without using the double or triple credits available for some generation choices). This would not only help Virginia exceed its mass-based standard by 5 percent, but also generate positive long-term economic and environmental benefits for the state. For example, as part of Virginia's 2014 Energy Plan, the state aims to become "the ideal manufacturing, operational and supply chain hub for offshore wind development in the mid-Atlantic region… provid[ing] support and resources to accelerate development of Virginia's offshore wind resources,"[60] which would create jobs and other economic benefits.

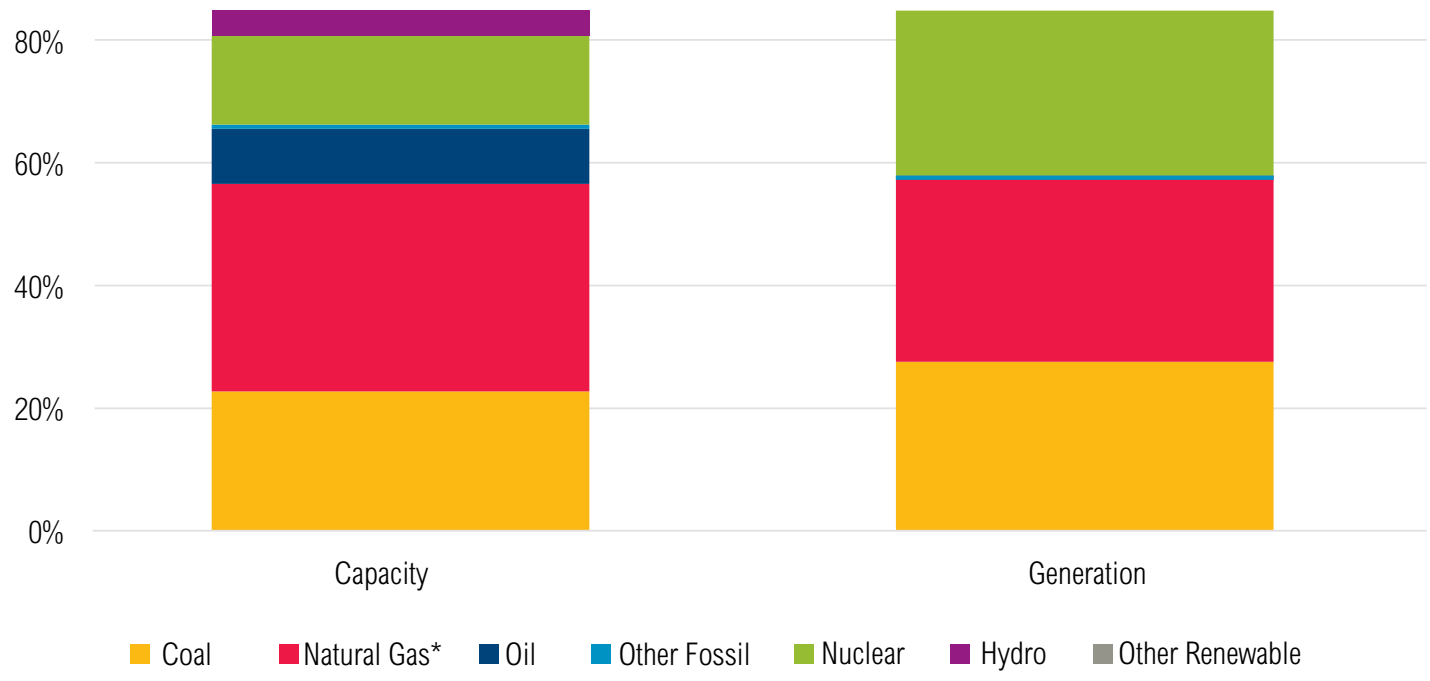
3. INCREASING THE USE OF EXISTING NATURAL GAS PLANTS

According to EIA data, the capacity factor of Virginia's existing combined cycle natural gas (NGCC) fleet was 60 percent in 2013—meaning that these plants generated less than the amount of electricity they are capable of producing.[61,62,63] As a result, natural gas comprised 29 percent of the state's generation, while it comprised 33 percent of total generating capacity (Figure 2). Dominion's two new NGCC plants were under construction as of January 2014 (coming online between 2015 and 2016) and are counted as part of Virginia's existing fossil fleet under the Clean Power Plan, giving the state even more opportunity to utilize its gas fleet over higher carbon generation.

OUTLOOK FOR VIRGINIA

Virginia is in a strong position to benefit from overcompliance with the Clean Power Plan while taking advantage of economic opportunities associated with market-based policies to reduce emissions. While Virginia has taken some steps to scale up renewable energy and energy efficiency, the state has a vast opportunity to build on its progress and achieve deeper, cost-effective emissions reductions going forward. If it makes better use of existing power plants and underutilized clean energy resources, Virginia will not only be in a good position to take advantage of the Clean Energy Incentive Program, but also will surpass the Clean Power Plan standards for its existing power plants. **Adopting EPA's new source complement standard would further incentivize zero-carbon generation sources and ensure that future CO_2 emissions from the state's power sector do not continue to increase.** These types of actions could create a new revenue stream for the state, given its potential to sell excess CO_2 allowances to other states looking for the most cost-effective ways to meet their own emissions standards. Doing so would also lead to increased investment throughout the state, and would make Virginia a clean-energy leader.

Figure 2 | **Virginia Generation and Generating Capacity by Fuel, 2013**



Note: *Figure 2 does not include the capacity and generation of the two "under construction" NGCC plants EPA includes in Virginia's baseline.

Box 3 | **About the Series**

In "Delivering on the U.S. Climate Commitment", WRI identified ten key actions the Obama administration must take in the absence of congressional action in order to meet the U.S. commitment to reducing greenhouse gas (GHG) emissions by 26–28 percent below 2005 levels by 2025. These actions include setting performance standards for existing power plants, reducing consumption of hydrofluorocarbons, reducing fugitive methane emissions from natural gas systems, and increasing energy efficiency. Of these ten actions, the greatest opportunity for reductions comes from the power sector. In his Climate Action Plan, President Obama directed EPA to work expeditiously to finalize carbon dioxide (CO_2) emission standards for new power plants and adopt standards for existing power plants. As states prepare to comply with these standards, it will be necessary to understand available opportunities for reducing CO_2 emissions from the power sector. This series of fact sheets aims to shed light on these opportunities by illustrating the potential for CO_2 emissions reductions in a variety of states. We show how these emissions savings stack up against the reductions required under the Clean Power Plan. This series is based on WRI analysis conducted using publicly available data. See the appendix for additional information on our methodology and modeling assumptions.[a]

Notes:

a. World Resources Institute. 2015. How States Can Meet Their Clean Power Plan Targets. Appendix A: Detailed Overview of Methods. Washington, DC: World Resources Institute.

POLICY FRAMEWORK AND INTERACTION

This analysis assumes the existing policies and other reduction opportunities discussed in the text are fully implemented. Depending on the combination of measures actually implemented by Virginia, each will have different impacts on the generation mix and resulting emissions. For example, increasing the use of existing combined cycle natural gas plants results in fewer emissions reductions in this analysis than would be the case if it were considered in isolation, because implementation of the renewable standard decreases the amount of coal-fired generation that would otherwise be available to shift to natural gas. The emissions reductions presented in the text are a result of each policy applied in the following sequence: (1) energy efficiency improvements applied to business-as-usual generation; (2) increased renewable generation applied to the resulting adjusted generation; (3) increased use of existing combined cycle natural gas units; and (4) increased efficiency of any remaining coal units. For consistency with EPA's approach, we include only the existing fossil fleet as part of our business-as-usual projections, and only new renewable generation and energy efficiency measures put into place after 2012.

ENDNOTES

1. Note: Virginia is a commonwealth, but for the sake of simplicity we refer to it as a state in this fact sheet.

2. We adjusted Virginia's 2012 emission levels for existing fossil plants to account for two of Virginia's new NGCC plants which were under construction as of January 2014 (Dominion's Brunswick County Power Station and Warren County plant). EPA counts these as existing sources and includes the generation and emissions from these plants under Virginia's baseline and compliance fossil emission rate and emission levels. Historical emission levels from: Annual Energy Review, U.S. Energy Information Administration, Accessible at: <http://www.eia.gov/electricity/data/state/emission_annual.xls>.

3. This is based on projections from Dominion Power and Appalachian Power (APCo), two of the largest investor-owned utilities in the state, as well as the Energy Information Administration's (EIA) *Annual Energy Outlook 2015* (AEO 2015). Dominion Power and Appalachian Power accounted for 83 percent and 2 percent of Virginia's generation in 2013, respectively. We relied on their projections of electricity generation by fuel type found in their annual integrated resource planning reports. Both utilities serve customers in neighboring states, so we apportioned each utility's generation projections to Virginia based on the proportion of electricity generated in each of their service states by fuel type as reported in EIA's Form 923 in 2013. Because EIA does not produce state-level projections, we relied on regional projections of annual electricity generation growth rates by fuel from AEO 2015 for the remaining electricity generated in Virginia. Because neighboring states have varying policies that will affect future in-state generation differently, these regional projections may not fully capture all the relevant trends that are expected to occur within a state's power sector. Because Virginia's renewable portfolio standard (RPS) and energy efficiency goals are voluntary, we did not adjust the projections to include any additional renewable generation or energy efficiency measures beyond what Dominion Power and APCo included in their integrated resource plans. However, the projections do include the utilities' planned coal plant retirements.

4. Because two of Virginia's new NGCC plants were under construction as of January 2014 (Dominion's Brunswick County Power Station and Warren County plant), EPA counts these as existing sources and includes the generation and emissions from these plants under Virginia's baseline. Under our business-as-usual projections, we hold the generation levels of the state's existing NGCC fleet constant between 2012 and 2030.

5. Virginia Acts of Assembly, 2007 Reconvened Session, Chapter 933. Accessible at: <http://leg1.state.va.us/cgi-bin/legp504.exe?071+ful+CHAP0933+pdf>.

6. US EIA: <http://www.eia.gov/electricity/sales_revenue_price/pdf/table5_a.pdf>.

7. Our analysis also finds that adopting measures and policies that help achieve its efficiency target can get Virginia 69 percent of the reductions needed to meet its rate-based emissions standard.

8. Virginia Acts of Assembly, 2013 Session, Chapter 2. Accessible at: <http://lis.virginia.gov/cgi-bin/legp604.exe?131+ful+CHAP0002>.

9. This equates to 8 percent of 2007 sales.

10. Anthony Lopez, Billy Roberts, Donna Heimiller, Nate Blair, and Gian Porro. 2012. "U.S. Renewable Energy Technical Potentials: A GIS-Based Analysis." National Renewable Energy Laboratory. Accessible at: <http://www.nrel.gov/docs/fy12osti/51946.pdf>.

11. Our analysis also finds that taking into account (a) the reductions already captured in our business-as-usual projections, and (b) achieving the state's energy efficiency goal, ensuring that Virginia's investor-owned utilities generate 15 percent of their electricity from renewable sources (relative to 2007 sales) by 2025 and beyond would achieve 79 percent of the reductions needed to meet its rate-based emissions standard.

12. WRI analysis indicates that increased use of the state's existing NGCC fleet, along with the increases in energy efficiency and renewable energy discussed below, would allow Virginia to be less dependent on coal-fired generation to meet its electricity needs. We therefore do not include supply-side efficiency (such as heat rate improvements) at coal-fired power plants as one of the emission reduction opportunities in this analysis.

13. Our analysis also finds that running existing (and under construction as of January 2014) NGCC plants at 75 percent can help the state reduce its fossil emissions rate to below the state's rate-based standard in 2030, in combination with the reductions captured in our business-as-usual projections and achieving its clean energy goals.

14. Accessible at: <http://yosemite1.epa.gov/EE/epa/eed.nsf/6058a0895486355785257662006 39df3/f9c8c8a37d6aab6f8525774200597f42!OpenDocument>.

15. This estimate of annual revenue from a $10 carbon price uses Virginia's interim and final mass-based targets between 2022 (31.3 million short tons of CO_2) and 2030 (27.4 million short tons of CO_2). Revenue in any given year will be higher or lower, depending on the response to the carbon price.

16. Analysis Group. 2011. The Economic Impacts of the Regional Greenhouse Gas Initiative on Ten Northeast and Mid-Atlantic States, accessible at: <http://www.analysisgroup.com/uploadedfiles/content/insights/publishing/economic_impact_rggi_report.pdf>; Analysis Group. 2015 The Economic Impacts of the Regional Greenhouse Gas Initiative on Nine Northeast and Mid-Atlantic States, Accessible at: <http://www.analysisgroup.com/uploadedfiles/content/insights/publishing/analysis_group_rggi_report_july_2015.pdf>.

17. PJM. 2015. "PJM Interconnection Economic Analysis of the EPA Clean Power Plan Proposal." Accessible at: <http://www.pjm.com/~/media/4CDA71CBEC864593BC11E7F81241E019.ashx>.

18. PJM. 2015. "PJM Economic Analysis of EPA's Proposed Clean Power Plan: State-Level Detail." Accessible at: <http://www.pjm.com/~/media/documents/reports/20150302-state-level-detail-pjm-economic-analysis-of-epas-proposed-clean-power-plan.ashx>.

19. http://www.eia.gov/electricity/sales_revenue_price/pdf/table5_a.pdf

20. http://emp.lbl.gov/sites/all/files/total-cost-of-saved-energy.pdf

21. EPA modeling of the CPP estimated that electricity bills for the average American will be 7–7.7 percent lower in 2030 due to changes in the average electricity price and demand.

22. Calculated using EIA data on the quantity and cost of coal shipments to electric utilities by state for 2010 through 2013 (http://www.eia.gov/coal/data.cfm).

23. https://www.whitehouse.gov/sites/default/files/image/climate/Virginia_Factsheet.pdf

24. C. Forbes Tompkins and Christina DeConcini. 2014. "Sea-Level Rise and its Impact on Virginia." Washington, DC: World Resources Institute.

25. Risky Business. 2015. "Come Heat And High Water: Climate Risk In The Southeastern U.S. And Texas," Accessible at: <http://riskybusiness.org/uploads/files/Climate-Risk-in-Southeast-and-Texas.pdf>.

26. U.S. Environmental Protection Agency. "What Are the Six Common Air Pollutants?" Accessible at: <http://www.epa.gov/airquality/urbanair/>.

27. U.S. Environmental Protection Agency. 2015. "Keeping Energy Affordable and Reliable." Accessible at: <http://www.epa.gov/airquality/cpp/fs-cpp-reliability.pdf>.

28. Susan F. Tierney. 2015. "How to Examine the U.S. Energy Information Administration's Report: Analysis of the Impacts of EPA's Clean Power Plan." Testimony Before the U.S. House of Representatives Committee on Science, Space and Technology, Subcommittee on the Environment and Subcommittee on Energy. Accessible at: <http://www.analysisgroup.com/uploadedfiles/content/news_and_events/news/tierney_testimony_house_science_and_technology_committee_6-22-2015.pdf>. Analysis Group. 2015. "Electric System Reliability and EPA's Clean Power Plan: Tools and Practices." Accessible at: http://www.analysisgroup.com/uploadedFiles/Content/Insights/Publishing/Electric_System_Reliability_and_EPAs_Clean_Power_Plan_Tools_and_Practices.pdf>.

29. For example, see: Brattle Group. 2015. "EPA's Clean Power Plan and Reliability Assessing NERC's Initial Reliability Review." Accessible at: <http://info.aee.net/hs-fs/hub/211732/file-2486162659-pdf/PDF/EPAs-Clean-Power-Plan--Reliability-Brattle.pdf?t=1438552731095>. Analysis Group. 2015. "Electric System Reliability and EPA's Clean Power Plan: Tools and Practices." Accessible at: <http://www.analysisgroup.com/uploadedFiles/Content/Insights/Publishing/Electric_System_Reliability_and_EPAs_Clean_Power_Plan_Tools_and_Practices.pdf>. Analysis Group. 2015. "Electric System Reliability and EPA's Clean Power Plan: The Case of MISO." Accessible at: <http://www.analysisgroup.com/uploadedfiles/content/insights/publishing/analysis_group_clean_power_plan_miso_reliability.pdf>.

30. C. Linvill, J. Migden-Ostrander, and M. Hogan. 2014. "Clean Energy Keeps the Lights On." Accessible at: <http://www.raponline.org/press-release/clean-energy-keeps-the-lights-on>.

31. PJM Interconnection, LLC. 2014. "PJM Renewable Integration Study." Prepared by General Electric International, Inc. <Accessible at: http://www.pjm.com/committees-and-groups/subcommittees/irs/pris.aspx>.

32. http://leg1.state.va.us/cgi-bin/legp504.exe?071+ful+CHAP0933+pdf

33. Commonwealth of Virginia Department of Mines, Minerals, and Energy. 2014. "Virginia Energy Plan." Accessible at: <http://www.dmme.virginia.gov/DE/LinkDocuments/2014_VirginiaEnergyPlan/VEP2014.pdf>.

34. Dominion Virginia Power. 2015. "2015 Dominion Virginia Power Integrated Resource Plan." Accessible at: <https://www.dom.com/library/domcom/pdfs/electric-generation/2015-irp-final-public-version-internal-cover.pdf>. William Shobe. 2015. "Dominion Virginia Power and Clean Power Plan Costs: A Brief Review of the Dominion's 2015 Integrated Resource Plan Compliance Cost Estimates." Center for Economic and Policy Studies and Frank Batten School of Leadership and Public Policy, University of Virginia. Accessible at: <http://www.coopercenter.org/sites/default/files/documents/CEPS_Report_15-02_0.pdf>.

35. These power purchases and generation projections cover Dominion's service areas in both Virginia and North Carolina. In 2013, 95 percent of Dominion's electricity sales and 86 percent of its generation occurred in Virginia and Dominion serviced around 70 percent of the state's electricity sales. Source: Form EIA-861. Accessible at: <http://www.eia.gov/electricity/data/eia861/>.

36. Appalachian Power. July 2015. "Integrated Resource Planning Report to the Commonwealth of Virginia State Corporation Commission."

37. This study's "Import Reduction" scenario will result in 122,912 job-years between 2012 and 2030. For more information, see: Advanced Energy Economy Institute and Virginia Advanced Energy Industries Coalition. 2015. "Assessing Virginia's Energy Future: Employment Impacts of Clean Power Plan Compliance Scenarios." Prepared by Meister Consultants Group. Accessible at: <http://info.aee.net/hubfs/PDF/aeei-virginia-energy-future.pdf?t=1431916562000>.

38. Annie Gilleo, Anna Chittum, Kate Farley, Max Neubauer, Seth Nowak, David Ribeiro, and Shruti Vaidyanathan. American Council for an Energy-Efficient Economy. October 2014. "The 2014 State Energy Efficiency Scorecard," Accessible at: http://www.aceee.org/sites/default/files/publications/researchreports/u1408.pdf.

39. US EIA: http://www.eia.gov/electricity/sales_revenue_price/pdf/table5_a.pdf

40. To model the state achieving its energy efficiency goal (6 TWh of savings in 2022), we assumed that existing efficiency efforts were ramped up starting in 2018 so that 0.2 TWh of additional annual savings were achieved beyond the savings included in Dominion and APCo's IRPs and that 4 TWh of additional savings were achieved in 2022.

41. http://leg1.state.va.us/cgi-bin/legp504.exe?151+sum+SB1349

42. http://leg1.state.va.us/cgi-bin/legp504.exe?151+ful+HB1446ER

43. Power plants that use combined heat and power can convert the useful thermal output to electricity generation for purposes of compliance. EPA estimated that Virginia's useful thermal output was equivalent to 1.1 TWh in 2012.

44. Other measures also include adopting and enforcing up-to-date building energy codes and setting state appliance standards that go beyond federal standards. For more information, see: <http://www.aceee.org/sites/default/files/publications/researchreports/u1408.pdf>.

45. Marilyn Brown, Etan Gumerman, Xiaojing Sun, Youngsun Baek, Joy Wang, Rodrigo Cortes, and Diran Soumonni. 2010. "Energy Efficiency in the South: Appendices." Georgia Tech and Nicholas Institute for Environmental Policy Solutions. Accessible at: <http://www.cepl.gatech.edu/sites/default/files/attachments/Energy%20Efficiency%20in%20the%20South%20Appendices.pdf>.

46. American Council for an Energy-Efficient Economy, Summit Blue Consulting, ICF International, and Synapse Energy Economics. 2008. "Energizing Virginia: Efficiency First." Accessible at: <http://www.aceee.org/sites/default/files/publications/researchreports/E085.pdf>.

47. In their analysis, Synapse assumed states ramped up their energy savings from near-term state-specific targets to 2 percent annual savings beginning in 2020. Patrick Knight, Patrick Luckow, Spencer Fields, Tommy Vitolo, Sarah Jackson, Bruce Biewald, and Elizabeth Stanton. 2015. "Bill Savings in a Clean Energy Future." Synapse Energy Economic, Inc. Accessible at: <http://synapse-energy.com/sites/default/files/Bill-Savings-in-a-Clean-Energy-Future.pdf>.

48. Commonwealth of Virginia Department of Mines, Minerals, and Energy. 2014. "Virginia Energy Plan." Accessible at: <http://www.dmme.virginia.gov/DE/LinkDocuments/2014_VirginiaEnergyPlan/VEP2014.pdf>.

49. We assumed utilities would not purchase out-of-state renewable energy certificates or make alternative compliance payments for any new renewable generation required for future compliance with renewable standards. Instead, we assumed each state complied with in-state renewable generation only. See: <http://lis.virginia.gov/cgi-bin/legp604.exe?131+ful+CHAP0002>.

50. EIA Annual Energy Review. Accessible at: <http://www.eia.gov/electricity/data/state/>

51. U.S. Energy Information Administration. "State Renewable Electricity Profiles." Accessible at: <http://www.eia.gov/renewable/state/>.

52. Solar Energy Industries Association. "State Solar Policy." Accessible at: <http://www.seia.org/state-solar-policy/virginia-solar, http://www.seia.org/state-solar-policy/north-carolina>.

53. Apex Clean Energy, "Our Projects," Accessible at: http://www.apex-cleanenergy.com/project-map.

54. Dominion. February 2015. "Dominion Virginia Power Planning Major Expansion of Large-Scale Solar in Virginia," Accessible at: <https://www.dom.com/corporate/news/news-releases/136979>.

55. BusinessWire, June 2015, "Amazon Web Services Announces New Renewable Energy Project in Virginia." Accessible at: <http://www.businesswire.com/news/home/20150610005653/en/Amazon-Web-Services-Announces-Renewable-Energy-Project#.VcjWjvlVhBc>.

56. Bob Fagan, Patrick Luckow, David White, and Rachel Wilson. 2013. "The Net Benefits of Increased Wind Power in PJM." Synapse Energy Economics, Inc. Accessible at: >http://www.synapse-energy.com/sites/default/files/SynapseReport.2013-05.EFC_.Increased-Wind-Power-in-PJM.12-062.pdf>. Josh Ryor and Letha Tawney. 2014. "Shifting to Renewable Energy Can Save U.S. Consumers Money." Washington, DC: World Resources Institute. Accessible at: <http://www.wri.org/blog/2014/06/shifting-renewable-energy-can-save-us-consumers-money>.

57. http://lis.virginia.gov/cgi-bin/legp604.exe?151+ful+HB2237H1+pdf

58. http://leg1.state.va.us/cgi-bin/legp504.exe?151+sum+HB2267

59. http://lis.virginia.gov/cgi-bin/legp604.exe?151+ful+SB1395H1

60. Commonwealth of Virginia Department of Mines, Minerals, and Energy. 2014. "Virginia Energy Plan." Accessible at: <http://www.dmme.virginia.gov/DE/LinkDocuments/2014_VirginiaEnergyPlan/VEP2014.pdf>.

61. WRI estimates based on data from U.S. Energy Information Administration, EIA-923 Generation and Fuel Data, <http://www.eia.gov/electricity/data/eia923/>; and EIA-860 Annual Electric Generator Data, <http://www.eia.gov/electricity/data/eia860/>.

62. NGCC units are designed to be operated up to 85 percent capacity (see http://mitei.mit.edu/system/files/NaturalGas_Chapter4_Electricity.pdf), but actual maximum capacity factors may differ among units. We assume a conservative maximum capacity factor of 75 percent. Because the majority of NGCC units are located in the northern and eastern part of the state, increasing the output from these existing units may cause transmission bottlenecks; potential transmission constraints should be studied further. Natural gas pipeline constraints also may occur, leading to price spikes. The state will need to consider both the near- and long-term potential cost differences between natural gas and coal as it weighs different compliance options.

63. We did not account for the increases in methane associated with the increased production of natural gas due to higher demand for the fuel. Going forward, industry should work with EPA to reduce methane leakage rates from natural gas systems. For additional information, see these WRI publications: "Reducing Methane Emissions from Natural Gas Development: Strategies for State-level Policymakers" (http://www.wri.org/publication/reducing-methane-emissions-natural-gas-development-strategies-state-level-policymakers), and "Clearing the Air" (http://www.wri.org/publication/clearing-the-air).

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ABOUT WRI

World Resources Institute is a global research organization that turns big ideas into action at the nexus of environment, economic opportunity and human well-being.

Our Challenge
Natural resources are at the foundation of economic opportunity and human well-being. But today, we are depleting Earth's resources at rates that are not sustainable, endangering economies and people's lives. People depend on clean water, fertile land, healthy forests, and a stable climate. Livable cities and clean energy are essential for a sustainable planet. We must address these urgent, global challenges this decade.

Our Vision
We envision an equitable and prosperous planet driven by the wise management of natural resources. We aspire to create a world where the actions of government, business, and communities combine to eliminate poverty and sustain the natural environment for all people.

Our Approach
COUNT IT
We start with data. We conduct independent research and draw on the latest technology to develop new insights and recommendations. Our rigorous analysis identifies risks, unveils opportunities, and informs smart strategies. We focus our efforts on influential and emerging economies where the future of sustainability will be determined.

CHANGE IT
We use our research to influence government policies, business strategies, and civil society action. We test projects with communities, companies, and government agencies to build a strong evidence base. Then, we work with partners to deliver change on the ground that alleviates poverty and strengthens society. We hold ourselves accountable to ensure our outcomes will be bold and enduring.

SCALE IT
We don't think small. Once tested, we work with partners to adopt and expand our efforts regionally and globally. We engage with decision-makers to carry out our ideas and elevate our impact. We measure success through government and business actions that improve people's lives and sustain a healthy environment.