Optimal ENERGY *Integrated Energy Resources*

POLICY BRIEF:
The Impacts of a Virginia Energy Efficiency Resource Standard

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Prepared for

Natural Resources Defense Council

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Contents

Tables

Figures

INTRODUCTION

Almost every state in the U.S. implements significant utility-delivered energy efficiency programs that reduce the need to use or build more expensive power plants. Energy efficiency has real and important impacts: per capita electric use declined by 7 percent between 2010 and 2016, even as gross domestic product (GDP) increased.[1] Two-thirds of lower energy use per GDP unit is from energy efficiency, with the other one-third due to structural changes in the economy.[2]

Energy efficiency programs make it easier for electric customers to access updated technology – like lighting, heating or air conditioning upgrades, and insulation – that improves performance and reduces energy consumption in homes and businesses. Efficiency programs impact energy use across the entire economy, from residential homes and apartments, through small commercial buildings, big box stores, and office towers, school campuses, and manufacturing facilities. Efficiency programs improve nearly every energy system, including heating, cooling, insulation, lighting, plug-in appliances, and energy-intensive industrial processes.

Energy efficiency is not only an available resource across all sectors of the economy. It's a significantly less expensive resource than power generation to meet the economy's total need for electricity, while lowering, instead of increasing, total monthly electric bills. A survey of energy efficiency across 20 states found the average cost of saved energy via improved efficiency to be $28 per megawatt hour (MWh), or 2.8 cents per kilowatt hour.[3] This is significantly lower than the $42-$55 per MWh cost to provide electricity from Virginia's largest source of electricity, combined cycle gas turbines.[4]

The lower cost of increasing energy efficiency, compared to building new power plants, is particularly true in Virginia. Dominion Energy's (Dominion) most recent integrated resource plan (IRP) shows the cost of energy efficiency in the range of $5-$33 per MWh, compared to $68-$78 per MWh for electricity produced by gas turbines.[5]

Despite that economic advantage, Virginia's efficiency programs lag behind almost every U.S. state: Virginia achieves efficiency savings of only 0.05 percent of statewide electric sales per year, compared to a U.S. average of 0.73 percent. Virginia's efficiency savings is less than one-tenth the national average.[6] Indeed, Virginia is the fifth-lowest state when ranked for efficiency savings.

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[1] U. S. Energy Information Administration (EIA), 2017. "Per Capita Residential Electricity Sales in the U.S. Have Fallen since 2010." July 26. https://www.eia.gov/todayinenergy/detail.php?id=32212.

[2] U.S. Department of Energy (DOE), 2017. *Staff Report to the Secretary on Electricity Markets and Reliability*. August. Figure 3-30: Estimated U.S. energy savings from structural changes in the economy and energy efficiency, 1980-2016: 55. https://www.energy.gov/sites/prod/files/2017/08/f36/Staff%20Report%20on%20Electricity%20Markets%20and%20Reliability_0.pdf?utm_source=newsletter&utm_medium=email&utm_campaign=newsletter_axiosgenerate&stream=politics.

[3] Molina, Maggie, 2014. "The Best Value for America's Energy Dollar: A National Review of the Cost of Utility Energy Efficiency Programs." Report Number U1402. March. Washington, DC: American Council for an Energy-Efficient Economy (ACEEE). Table S1: Summary of results for four-year averages (2009 – 2012) for all states in dataset: v. https://aceee.org/sites/default/files/publications/researchreports/u1402.pdf.

[4] EIA, 2019. "Levelized Cost and Levelized Avoided Cost of New Generation Resources in the *Annual Energy Outlook 2019."* February. https://www.eia.gov/outlooks/aeo/pdf/electricity_generation.pdf.

[5] Dominion Energy, 2018. *Virginia Electric and Power Company's Report of Its Integrated Resource Plan*. Before the Virginia State Corporation Commission and North Carolina Utilities Commission; Public Version. Figure 5.5.4.3: Comparison of per MWh costs of selected generation resources: 96. https://www.dominionenergy.com/library/domcom/media/about-us/making-energy/2018-irp.pdf.

[6] ACEEE, 2019. The State Energy Efficiency Scorecard. https://aceee.org/state-policy/scorecard.

Meanwhile, 18 states achieve efficiency rates at levels 20-40 times greater than Virginia.[7]

This has a direct impact on Virginia's economy: Virginia's average electric bills are higher than they need to be. Over the last decade, Virginia electric rates have increased, significantly and repeatedly. Rates have increased for residential customers by almost one-third in the last decade,[8] with an increase of 71 percent for Appalachian Power (APCo) customers.[9] In 2018, only 6 states had higher average residential electric bills than Virginia's average monthly bill of $136.59. Further, Dominion plans significant bill increases in the near term, with increases of nearly $30 per month planned by 2023 for residential customers.[10,11]

In contrast, increasing energy efficiency in Virginia would provide needed relief to electric customers and also deliver low-cost carbon savings to meet the Commonwealth's 2030 carbon reduction requirement. Virginia utilities are not likely to do this on their own: energy efficiency reduces electric sales, and thus utility revenue, even despite ongoing annual overearnings.[12] Policy intervention is needed to ensure Virginians can easily access efficiency technology, to lower household costs and statewide carbon emissions.

A common means to ensure robust energy efficiency is legislative enactment of an energy efficiency resource standard (EERS), a requirement that utilities deliver minimum annual savings through efficiency program offerings to customers. Beginning with Texas, most states in the U.S. already have an EERS in place. Seven of those states make even deeper efficiency investments by requiring that utilities harvest all available cost-effective energy efficiency.[13]

State EERS adoption has worked: states with an EERS achieved energy savings of 1.2 percent of retail sales in 2017, a level four times above states that lack an EERS (0.3 percent of sales).[14] Several of Virginia's nearby mid-Atlantic states have substantial EERS goals in place, including Maryland (2 percent per year), Pennsylvania (0.8 percent per year), and New Jersey (requiring that all cost-effective energy efficiency savings be achieved, with a minimum of at least 2 percent per year within five years).[15]

Given steadily rising bills and increasing carbon emissions in Virginia, an EERS is an important tool for policymakers to consider. This report estimates the impacts that a Virginia EERS eventually requiring 2 percent savings per year would have on the Commonwealth's electric system, ratepayers, and the environment.

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[7] Id.

[8] EIA, n.d. "Electricity." Data tab. https://www.eia.gov/electricity/data.php.

[9] Commonwealth of Virginia, 2018. "Status Report: Implementation of the Virginia Electric Utility Regulation Act," In *Combined Reports*. Presented to the Governor of the Commonwealth of Virginia, the Chairman of the Senate Committee on Commerce and Labor, the Chairman of the House Committee on Commerce and Labor, and the Commission on Electric Utility Regulation of the Virginia General Assembly. Richmond: State Corporation Commission. August 29. https://www.scc.virginia.gov/comm/reports/2018_veurcomb.pdf.

[10] EIA, 2018. "Average Monthly Bill – Residential." Data from forms EIA-861, schedules 4A-D, EIA-861S and EIA-861U. https://www.eia.gov/electricity/sales_revenue_price/pdf/table5_a.pdf.

[11] Walton, Robert, 2019. "Virginia Regulators Approve Revised Dominion IRP, but Warn about Understated Costs." *Utility Dive Brief,* June 28. https://www.utilitydive.com/news/virginia-regulators-approve-revised-dominion-irp-but-warn-about-understate/557853/.

[12] Many states address the issue of lost revenue by decoupling, so that utility earnings are not adversely affected by energy efficiency. See National Renewable Energy Laboratory (NREL), n.d. "Decoupling Policies: Options to Encourage Energy Efficiency Policies for Utilities." In *Clean Energy Policies in States and Communities*. https://www.nrel.gov/docs/fy10osti/46606.pdf.

[13] ACEEE, 2019. "State Energy Efficiency Resource Standards (EERS). " https://aceee.org/sites/default/files/state-eers-0519.pdf.

[14] Id.

[15] Id.

THE VIRGINIA CONTEXT: LOW EFFICIENCY SAVINGS, INCREASING BILLS

VIRGINIA'S EFFICIENCY SAVINGS ARE NEAR THE BOTTOM IN THE NATION

Virginia's current efficiency savings are extremely low compared to other states. In 2018, Virginia's utility efficiency programs achieved the fifth-lowest rate of electric savings in the nation, at only **0.05 percent of total electricity sold**.[16] Only four states have lower performance in efficiency savings (Alabama, Alaska, Kansas, and North Dakota). On average, efficiency savings across the U.S. are almost 15 times higher than what Virginia utilities achieve, and 18 states save more than 1.0 percent per year (20 times Virginia's savings rate). Thirty-two states achieve at least 10 times Virginia's rate. The appendix contains data for all jurisdictions with higher savings rates than Virginia.[17]

Dominion ranked 50th in efficiency, out of the 51 largest electric utilities in the country, in the American Council for an Energy Efficient Economy's (ACEEE) 2017 *Utility Energy Efficiency Scorecard*. Dominion earned low scores for its energy efficiency performance, its programs overall, and for the lack of stringency in its targets.[18] This low efficiency corresponds with Virginia's high electric bills.

VIRGINIA RATES AND BILLS HAVE STEADILY INCREASED AND WILL CONTINUE INCREASING

The value of increased energy efficiency is particularly relevant for Virginia customers, whose average electric bills have steadily increased and are now the seventh-highest in the nation.[19] In just the ten-year period from 2007 to 2016, residential electric bills increased significantly for both Dominion and APCo customers, with Dominion bills for a 1,000 kilowatt hours (kWh) per month residential consumer increasing 27 percent, and APCo bills increasing 74 percent.[20] Dominion proposes additional significant increases in the near term of nearly $30 per month.[21] Figure 1 shows past bill increases for both utilities, and a projection of Dominion's expected increases.

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[16] ACEEE 2019 State Energy Efficiency Scorecard. https://aceee.org/sites/default/files/publications/researchreports/u1908.pdf.

[17] See appendix to this report.

[18] Relf, Grace, Brendon Baatz, and Seth Nowak, 2017. "2017 Utility Energy Efficiency Scorecard." Report U1707, June. Washington, DC: ACEEE. This 2017 report is the latest available. https://aceee.org/sites/default/files/publications/researchreports/u1707.pdf.

[19] EIA, 2018. "Average Monthly Bill – Residential." https://www.eia.gov/electricity/sales_revenue_price/pdf/table5_a.pdf.

[20] Commonwealth of Virginia, 2018. "Status Report: Implementation." https://www.scc.virginia.gov/comm/reports/2018_veurcomb.pdf.

[21] Commonwealth of Virginia, 2019. State Corporation Commission, *Final Order in re: Virginia Electric and Power Company's Integrated Resource Plan filing pursuant to Va. Code § 56-597 et seq.* Case No. PUR-2018-00065: 5. http://www.scc.virginia.gov/docketsearch/DOCS/4hfb01!.PDF.

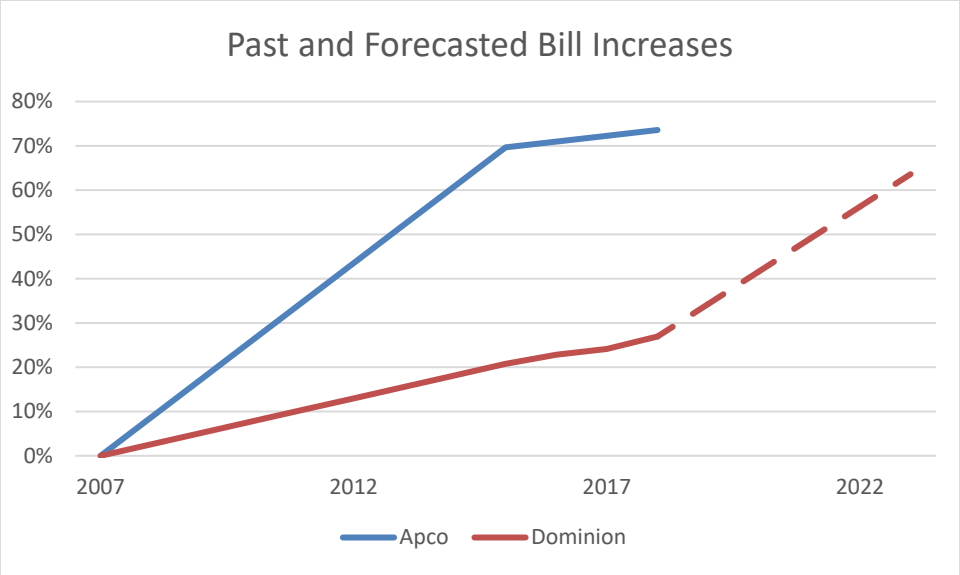

Figure 1. Increase in residential electric bill for customers using 1000 kWh per month.

The above figure highlights the importance of bills, as opposed to base rates. Despite the history of higher-than-inflation bill increases shown above, Virginia's underlying electric base rates are fairly typical in comparison to other states.[22] However, the average monthly residential bill (as opposed to the residential rate) is higher than the averages for all but six states, due to higher consumption. Some of that higher use is due to significant statewide use of electric heat (which itself presents a significant energy efficiency savings opportunity, discussed below). Much is also due to the lack of robust utility-driven efficiency programs that have offset the effects of similar rate increases in other states.

Efficiency deployment could have been a significant hedge against these increases. For example, a 2017 study from the Virginia Poverty Law Center found that 68 percent of this rate increase was from new generation and transmission costs – the kind of costs that can specifically be avoided through effective efficiency programs; 29 percent of the increase is due to higher fuel prices – a cost that would also be mitigated through efficiency.

It is critically important that Virginia strengthen efficiency to help residents offset rising electric costs, which Dominion plans to increase by over 20 percent by 2023.[23] These increases are largely driven by increases in fuel prices and Dominion's need to build more power plants or make transmission upgrades; all things that efficiency could have mitigated.

[22] EIA data show Virginia with a cost of $0.1174 per kWh, compared to a U.S.-wide cost of $0.1287. EIA, 2018. "Average Monthly Bill – Residential." https://www.eia.gov/electricity/sales_revenue_price/pdf/table5_a.pdf.

[23] EIA data show Viriginia's average residential bill to be $136.59 per month. A $30 increases represents 20 percent. https://www.eia.gov/electricity/sales_revenue_price/pdf/table5_a.pdf.

VIRGINIA UTILITIES NOT MEETING NON-BINDING GOALS

Virginia's attempt to increase energy efficiency via an optional goal has failed. In March of 2007, Virginia set a non-binding goal to reduce electric energy consumption of investor-owned utilities 10 percent by 2022.[24] If spread out over 16 years (2007-2022), this equates to an incremental annual goal of 0.625 percent. As of 2017, neither Dominion nor APCo have been close to achieving this goal for even a single year, as the figure below shows.[25]

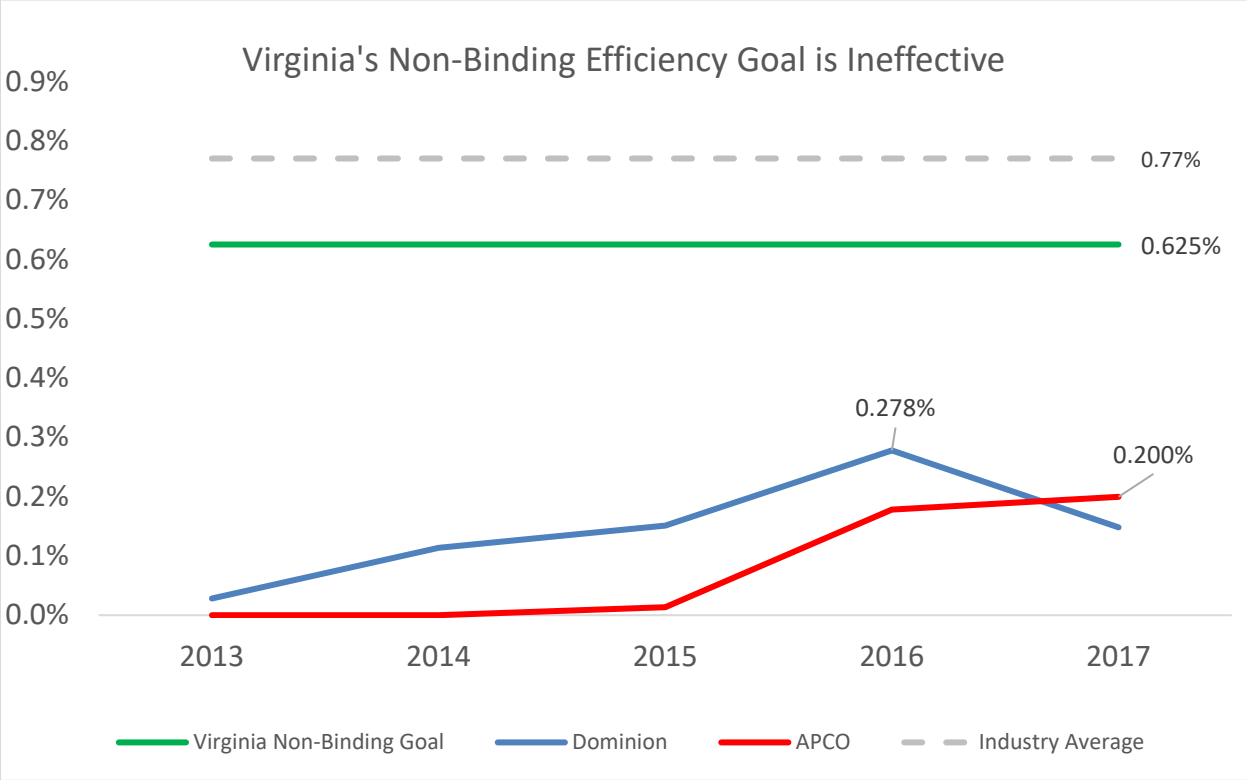

Figure 2. Savings as a percent of sales, Dominion and APCo, Virginia non-binding goal, and industry average, 2013-2017.

Non-binding targets have not proven effective at motivating utilities to deliver robust efficiency programs in Virginia, and Virginia's utility savings have in fact recently trended in the opposite direction. This suggests that a binding target is needed to ensure increased savings, lower bills, and decreased pollution.

[24] DOE, 2016. "Energy Efficiency Resource Goal." Raleigh: NC Clean Energy Technology Center, DSIRE. https://programs.dsireusa.org/system/program/detail/5056.

[25] Self-reported energy efficiency savings. https://www.eia.gov/electricity/data/eia861/.

VIRGINIA LAGS IN EFFICIENCY, DESPITE RECENT COMMITMENTS

The recently passed Grid Transformation and Security Act (GTSA) is an effective step to prioritize efficiency programs. Among other things, the legislation calls for Dominion and APCo to propose more efficiency programs, requiring that Dominion propose $870 million and APCo propose $140 million, in energy efficiency and demand response programs over the next decade.[26]

In response, Dominion has proposed and gained approval for 11 new energy efficiency and demand response programs at a cost of $225.8 million over a five-year period.[27] While a good first step at $45 million per year, investments will need to increase dramatically in later years to meet the legislative target. For reference, Dominion invested approximately $31 million on energy efficiency in 2015, or less than 0.5 percent of its revenue.[28] The average efficiency spending of other large utilities that same year was 2.7 percent of revenue.[29] While the new commitments represent a significant improvement from current efficiency investment, they fall well short of the average efficiency investment of U.S. utilities, and do not put Dominion on track to achieve the $870 million target. Even assuming Dominion will ramp up to reach the goals set by the GTSA, it is inadequate as 1) the legislation focuses on spending as opposed to delivering customer savings, and 2) that investment level is significantly below the achievable cost-effective potential, as shown by achievements in peer states.

The table below shows annual savings as a percent of sales projected for Dominion under the current commitment, as well as for both Dominion and APCo assuming the full GTSA commitment is made.

Table 1. Average annual efficiency savings as a percent of retail sales, projected, 2020-2023

	Annual savings as a percent of sales
Dominion savings - current commitment[30]	0.25%
Dominion savings - full GTSA[31]	0.86%
APCo savings - full GTSA[32]	0.79%
2015 large utility average[33]	0.89%

The above table shows the extent to which Virginia utilities continue to lag other large utilities in the U.S.: Dominion's GTSA commitment will yield less than one-third of the savings of the average large utility in 2015, and even under the full GTSA investment, savings for both utilities are still projected to be significantly lower than what typical large utilities have achieved.

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[26] Virginia General Assembly, 2018. "SB 966 Electric Utility Regulation; Grid Modernization, Energy Efficiency." Richmond: Virginia's Legislative Information System (LIS). https://lis.virginia.gov/cgi-bin/legp604.exe?181+sum+SB966.

[27] Commonwealth of Virginia, 2018. State Corporation Commission, Case No. PUR-2018-00168, *Order for Notice and Hearing*. http://www.scc.virginia.gov/case/e-notice/nr180168.pdf.

[28] Relf et al., 2017. "2017 Utility Energy Efficiency Scorecard." https://aceee.org/sites/default/files/publications/researchreports/u1707.pdf.

[29] Id.

[30] Savings from Direct Testimony of Deanna R. Kesler. Case Number PUR-2018-00168. http://www.scc.virginia.gov/docketsearch/DOCS/4f%23q01!.PDF. Costs from Dominion IRP.

[31] Assumes that the cost per kWh under GTSA is the same as current commitments, and spending scales up from the approximate $25 million per year as shown in Kesler testimony to the $87 million per year required under GTSA.

[32] Assumes the same cost per MWh as Dominion's current commitment and $170 million in spending per year, as required by the GTSA.

[33] Relf et al., 2017. "2017 Utility Energy Efficiency Scorecard." https://aceee.org/sites/default/files/publications/researchreports/u1707.pdf.

TWO PERCENT ENERGY EFFICIENCY RESOURCE STANDARD

An EERS similar to those implemented in 27 other states could elevate Virginia to a leadership position in energy efficiency, and offset the economic cost of recent and planned rate increases, while also making significant carbon reductions toward Virginia's 30 percent target in 2030.[34]

The rest of this report examines how a 2 percent EERS in Virginia might be implemented and its likely impact on Virginia's electric bills and carbon emissions, and shows some of the specific benefits that would result.

A 2 PERCENT EERS WILL AFFORDABLY ELIMINATE ELECTRIC LOAD GROWTH

Energy efficiency has significantly decreased America's per capita electricity consumption: America's per capita electric use decreased by 7 percent between 2010 and 2016.[35] That decrease occurred despite growth in both population and GDP, leading to a 3 percent decrease in total U.S. electric sales.[36]

Virginia is an exception to the national trend of decreasing electricity use: as seen in Figure 3 below, Virginia's electric sales have instead increased, and are forecasted by some to continue their steady increase over the next decade.[37] As described above, EERSs have helped successfully eliminate, and even reversed, electric load growth in other states.

This section examines an EERS in Virginia and provides estimates of how it might impact electric load and prices. To do so, both implementation costs and electricity savings were estimated for a Virginia EERS that would ramp up to 2 percent incremental annual savings in five years,[38] and then remain constant at 2 percent.[39] This savings rate has already been achieved in several states that are leaders in energy efficiency.[40] The EERS would apply only to Virginia's two largest investor-owned utilities, Dominion and APCo. We assume that savings will increase by 0.35 percent per year – a ramp-up rate that has been achieved in other states that have implemented strong EERS.[41] When Massachusetts ramped up savings to achieve all cost-effective efficiency, it steadily increased by about 0.35 percent per year from 1.3 percent savings in 2010, to 3.3 percent savings in 2016.[42] Rhode Island also went from achieving 1.3 percent savings in 2011 to 2.8 percent in 2015, an average increase of about 0.39 percent per year.[43] In addition, because Massachusetts and Rhode Island were already doing aggressive efficiency programs—and had

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[34] Virginia Department of Environmental Quality, 2019. "Virginia Adopts Regulation to Limit Carbon Pollution, Fight Climate Change," April 19. https://www.deq.virginia.gov/ConnectWithDEQ/NewsReleases/CarbonRule.aspx.

[35] EIA, 2017. "Per Capita Residential Electricity Sales." https://www.eia.gov/todayinenergy/detail.php?id=32212.

[36] Id.

[37] Forecast and history from Dominion and APCo integrated resource plans.

[38] The analysis assumes a start year of 2020. However, this could be shifted a year or two, depending on the timing of the legislation, and the resulting figures would be approximately the same.

[39] *Incremental annual savings* refers to the Year 1 impact of efficiency measures installed in that program year. *Total cumulative savings* represent the total reduction from all previous program years.

[40] ACEEE, 2019. "State Energy Efficiency Scorecard." https://aceee.org/research-report/u1908. Shows three states with greater than 2 percent savings in 2018.

[41] "Welcome to Mass Save Data," 2018. https://www.masssavedata.com/Public/SalesAndSavings.

[42] Id.

[43] Northeast Energy Efficiency Partnership. Regional Energy Efficiency Database. https://reed.neep.org/. Accessed November 2019.

been for years—that ramp-up was likely more ambitious because nominal percentage increases become progressively more difficult as goals increase. Virginia is starting from a much lower baseline than Massachusetts and Rhode Island; both of which had been national leaders in efficiency since the 1980s. Ramping up at these levels should be more readily achievable in Virginia, as ramping up becomes progressively more difficult as goals increase. As further evidence, a 2016 ACEEE study looked at ramp rates for 93 different program administrators. It found that 44 of the 93 ramp rates were higher than 0.2 percent, and that a full 20 percent were higher than 0.5 percent. This is further evidence that a 0.35 percent ramp rate should be highly achievable in Virginia.[44]

Virginia's high rate of building electrification, particularly in electric space heating (as discussed below), also provides significant savings opportunities that many other high-achieving states, including Massachusetts and Rhode Island, do not have. Potentially constraining that savings potential, however, are the effects of any opt-outs available for commercial customers. That is why efficiency programs under an EERS should include all customers. Alternatively, any opt-out should be accompanied by a requirement for self-directed energy efficiency, with required measurement and verification of results. Opt-outs are discussed in more detail below.

Under a 2 percent EERS, Virginians would see significant energy savings: Dominion and APCo would achieve a combined cumulative energy use reduction of 13,382 GWh by 2029. Put in perspective, that is approximately 14 percent of Virginia's electric retail load. The figure below shows recent Virginia electric use, with the consumption increases forecasted by Dominion and APCo through 2029, compared to the reduction in energy use a 2 percent EERS would deliver to Virginians.[45,46]

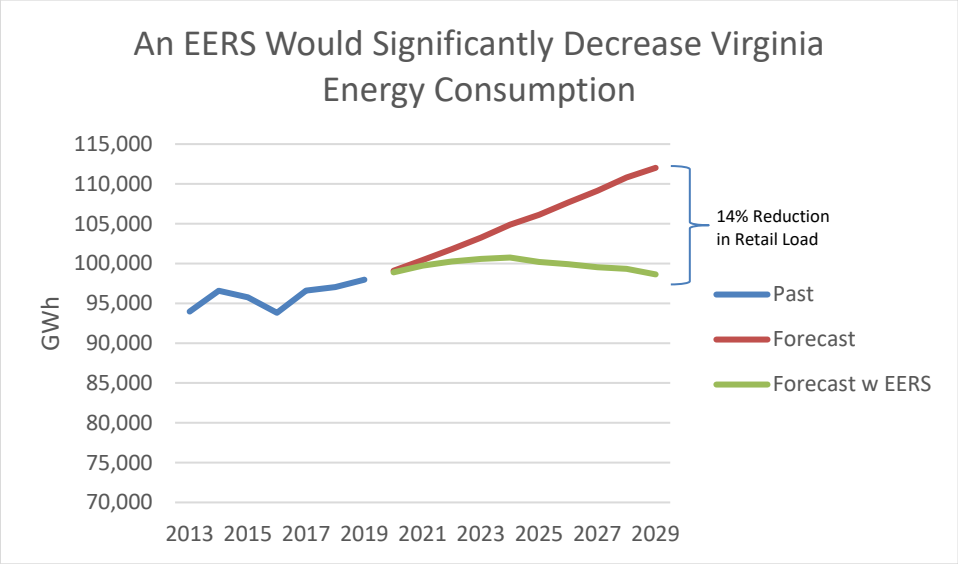

Figure 3. Virginia retail electric sales, with and without an EERS, 2013-2029.

[44] ACEEE, 2019. "Big Savers: Experiences and Recent History of Program Administrators Achieving High Levels of Electric Savings." https://aceee.org/research-report/u1601.

[45] Dominion Energy, 2018. *Integrated Resource Plan*. https://www.dominionenergy.com/library/domcom/media/about-us/making-energy/2018-irp.pdf.

[46] Appalachian Power Integrated Resource Plan. 2019.

As seen above, a 2 percent EERS would initially still result in some growth in energy consumption. However, once ramped up, an EERS would eliminate load growth and begin to reduce total consumption, through 2029, when total consumption would be near 2020 levels. The annual incremental savings Dominion and APCo would achieve using the assumed ramp-up rate discussed above are shown in the table below.

Table 2. Estimated incremental annual MWh savings with 2 percent EERS, Dominion and APCo, by sector, 2020-2025

	2020	2021	2022	2023	2024	2025
Residential	104,383	254,034	408,073	566,482	731,214	898,340
Low Income	8,351	20,323	32,646	45,319	58,497	71,867
C&I	96,032	233,711	375,427	521,163	672,717	826,473
Total	208,765	508,068	816,145	1,132,963	1,462,428	1,796,680

The assumed cost to deploy efficiency programs under a Virginia EERS relied on data on cost per unit saved from peer states and states that have high savings.[47] The table below shows those estimated costs, as well as spending as a percent of utility revenue represented. Large customers that are excluded from the efficiency programs make up a large portion of Virginia's commercial and industrial (C&I) load. Because efficiency is less expensive in C&I facilities, the total cost to achieve would decrease if the full base of C&I customers are included.

Table 3. Virginia estimated program costs with 2 percent EERS ($ millions), by sector, 2020-2025

	2020	2021	2022	2023	2024	2025
Residential	$24	$59	$95	$132	$170	$209
Low income	$6	$14	$23	$32	$42	$51
C&I	$23	$57	$91	$127	$164	$201
Total	$54	$131	$210	$291	$376	$462
Spending as percent of revenue	0.60%	1.47%	2.36%	3.28%	4.23%	5.20%

VIRGINIA SHOULD REMOVE ITS HIGHLY RESTRICTIVE LIMIT ON EFFICIENCY PARTICIPATION BY LARGER CUSTOMERS

To maximize EERS energy and bill savings, all customers should be included in utility program eligibility. However, under recently changed Virginia law, a very significant percentage of customers – those with demand above 500 kW – are automatically excluded from electric utility efficiency programs.[48] This is one of the most significant restrictions on efficiency potential in the country, and one that policymakers should strongly consider revising. (Prior to this significant

[47] We look at Illinois, Maine, Massachusetts, Pennsylvania, and Vermont, and have obtained cost data from their most recent annual reports.

[48] Code of Virginia. Section 56-585.1. https://law.lis.virginia.gov/vacode/title56/chapter23/section56-585.1/.

restriction on efficiency participation, which was included in 2018's GTSA, certain larger customers could voluntarily opt-out of programs, so long as they achieved energy efficiency savings on their own, a flexible option known as *self-direct*.)

The EERS has been modeled assuming that the current restriction on 500 kW+ customer participation remains. The 500 kW level results in exemption of a very large amount of Virginia's retail electric load, assumed to be approximately one-third of total retail load. This has the effect of turning a full statewide 2 percent EERS to a 3 percent EERS on the remaining eligible customers (total customer load less 500 kW+ customers). The remaining eligible load is two-thirds residential, a sector historically more expensive for efficiency programs to reach. Larger C&I customers typically participate in inordinately large numbers, and deliver a very high portion of savings at a lower cost than smaller C&I and residential customers.

We therefore recommend that the EERS remove the 500 kW+ restriction and include the entire electric customer base, with an option for larger customers that prefer to self-direct their own efficiency programs, with proper measurement, verification, and reporting of results. This will make the EERS savings target both more achievable and more cost-effective, as well as deliver greater benefits to all customers and the Virginia economy, including greater emissions reductions. If the 500kW+ exclusion remains in place as is, a significant amount of cost-effective potential in Virginia is excluded from participation. The residential sector will need to achieve nearly 3 percent of savings per year, in an environment when lighting savings are mostly no longer available. Small C&I will likely need to achieve over 3 percent savings, another feat that would be very difficult to achieve. If the current opt-out policy is not updated, the savings goals estimated in this paper will become very difficult to achieve, and will likely have to be modified.

THE INVESTMENT REQUIRED TO MEET A VIRGINIA EERS IS SIMILAR TO OTHER STATES

Meeting the EERS requires significant increases in efficiency investment, just as the alternative of meeting increasing energy demand requires significant—and actually larger – investment in power plants, transmission, and distribution system upgrades. Annual efficiency program costs under an EERS would reach $462 million by 2026, or half of the utilities' total 10-year spending target from the GTSA. This level of spending represents about 5.2 percent of total utility revenue, putting Dominion and APCo in line with Ameren Illinois, Baltimore Gas and Electric, Com Ed, Eversource Connecticut, MidAmerican Iowa, Portland General Electric, and Puget Sound Energy, each of which spends between 4 and 6 percent of revenue on efficiency.[49] For comparison, the large utilities in Massachusetts, the nation's leading state in energy efficiency savings, invest more than 10 percent of revenue on energy efficiency.[50] By design, the investment delivers bill savings that are greater than efficiency investment costs, resulting in lower customer bills, as well as significant decreases in power plant pollution.

[49] Relf et al., 2017. "2017 Utility Energy Efficiency Scorecard." https://aceee.org/sites/default/files/publications/researchreports/u1707.pdf.
[50] Id.

A 2 PERCENT EERS WILL LOWER VIRGINIANS' ELECTRIC BILLS

An EERS will pay for itself with bill savings from efficiency programs that are greater than efficiency program costs. Those program costs would be covered through a rate adjustment clause (RAC), a small per kWh surcharge used to fund investments and costs additional to the base rate. The analysis below demonstrates how an EERS RAC would be offset by a decrease in the total bills, due to the lower usage, which would result in average bill reductions for Virginians.

The table below shows the RAC increase needed to fund a 2 percent EERS,[51] assuming that, similar to supply side investments, program costs are amortized over the average measure life of the installed technology of 10 years, and that the utilities will also earn a return on the program investment of 9.2 percent.

Table 4. Estimated rate increase ($ and %) and average bill effect (%) from a 2 percent EERS, 2020-2029, amortized

		2020	2021	2022	2025	2029
Per kWh increase	Res	$0.0001	$0.0005	$0.001	$0.004	$0.010
	C&I	$0.0002	$0.001	$0.001	$0.005	$0.013
Rate effect	Res	0.1%	0.5%	1.0%	4.0%	9.9%
	C&I	0.2%	0.8%	1.8%	7.2%	17.9%
Average bill effect[52]	Res	-0.2%	-0.7%	-1.4%	-5.4%	-11.7%
	C&I	-0.3%	-0.9%	-1.8%	-6.5%	-13.7%

As the table shows, total customer rate impacts would be negligible in the early years, increasing to one-tenth of a cent in year three. For a residential customer using 1,000 kWh per month, this equates to approximately $1.00 per month to pay for efficiency programs. By year 5, with a significant expansion of deployed efficiency programs, the total cost impact via RACs increases to approximately half a cent per kWh, or $5 per month.

That increase, due to the cost of deploying significant efficiency programs, however, would be more than offset by a decrease in total bills, as customers increase efficiency. The figure below shows the change in projected total bills (in all sectors) for APCo and Dominion customers from 2019 to 2029 under a scenario with no EERS and one with an EERS.[53] Due to load growth, bills

[51] We do not include lost revenue recovery because 1) it is not a cost of efficiency, per se; these costs might include fixed costs that would be covered, regardless; 2) there are many different ways to handle lost revenue recovery, including RACs, rate cases, and decoupling; and 3) lost revenue recovery is not currently included in Dominion's planned programs.

[52] This shows the average bill impact, including both participants and non-participants. While the bill impact for participants only will be highly variable depending on sector, specific efficiency program, and number of times participated, typical savings for participants may approach 20% for residential customers and 27% for C&I customers.

[53] This is high-level analysis isolating the direct impact of efficiency programs. A complete analysis would look at lost revenue requirements, impact on supply side generation, reduction in transmission and distribution (T&D) expenditures, price effects from lower demand, and more. Further, the baseline case assumes a constant $ / kWh from today's level, whereas the EERS case uses the baseline rate plus the additional rate from recovery of the efficiency programs. Neither scenario includes the proposed rate increase that Dominion has proposed; including that scenario would likely increase the bill savings from the EERS.

initially increase slightly in the short term. However, under an EERS, total bills decrease by 12 percent below what they would be in 2029.

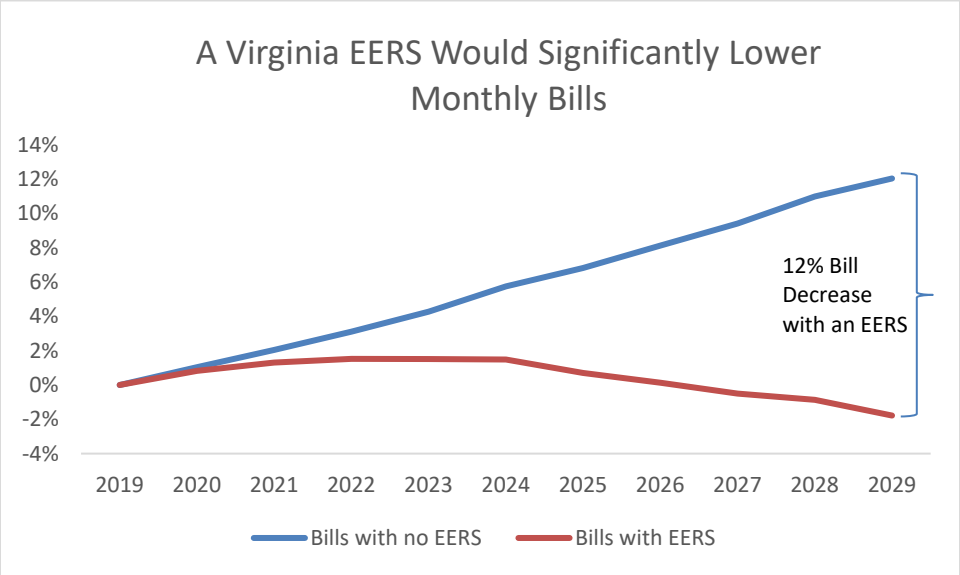

Figure 4. Change in total residential, commercial, and industrial electric bills, with and without EERS, 2019-2029.

The above figure reflects efficiency's downward impact of 12 percent on total monthly electric bills. Any increase in RAC costs for individual households is outweighed by even minimal participation in available efficiency programs, as is reflected in other states. As one example, the average residential participant in Vermont's 2018 lighting upgrade program alone saved 43 kWh per month.[54] Assuming a Virginia LED lighting upgrade program achieves similar savings and the LED upgrade is in place for 15 years, the participant will save a total of $840 over its life. Indeed, the primary purpose of efficiency programs is delivering those lower net costs over the life of the technology deployed.

Many states with high efficiency savings yield similar cost-saving results, when utilities make efficiency programs widely available and effectively marketed. A Massachusetts study found an average total residential bill reduction of $2 per month with near universal participation – even despite the state's long-term average rate increase of 2.1 percent.[55] A study in Vermont found that three years of efficiency programs lowered participant bills by up to 24 percent, depending on the program.[56] The same analysis found that, over time, nearly every eligible ratepayer had participated in an efficiency program. A Rhode Island analysis found bill reductions of 1.67

[54] Efficiency Vermont, 2019. *Efficiency Vermont 2018 Savings Claim Summary*. Burlington, VT: VEIC: 53. https://www.efficiencyvermont.com/Media/Default/docs/plans-reports-highlights/2018/2018-savings-claim-summary.pdf. Derived from Table 3.17.

[55] Woolf, Tim, 2013. "Energy Efficiency: Rate, Bill and Participation Impacts." Presentation at *Energy Efficiency as a Resource* Conference. September 24. Washington, DC: ACEEE. https://aceee.org/files/pdf/conferences/eer/2013/5C-Woolf.pdf.

[56] Woolf, Tim, Erin Malone, and Jenn Kallay, 2014. "Rate and Bill Impacts of Vermont Energy Efficiency Programs: From Proposed Long-term Energy Efficiency Scenarios 2014 – 2034." Montpelier, VT: Vermont Public Service Department, April 23. https://www.synapse-energy.com/sites/default/files/SynapseReport.2014-04.VT-PSD.VT-EE-Bill-Impacts.13-088.pdf.

percent (net of the rate increase) for residential participants, and bill reductions of up to 23 percent for C&I participants, depending on the program.[57]

Given these delivered benefits of efficiency in successful programs, the best way to avoid net upward rate impacts on monthly bills is not to restrict program budgets, which limits the accessibility of the program benefits to a smaller subset of the population, and therefore reduces net bill savings. Indeed, such limitations on available efficiency programs create significant inequities in who can and cannot access energy efficiency savings. Instead, the best approach to ensure net bill savings for the most customers is to design and implement a suite of comprehensive programs that allow and encourage every segment of each customer class to participate. Studies in states with long histories of robust efficiency show near universal participation in efficiency programs is achievable, which in turn outweighs rate increases needed to fund those successful programs.[58]

A 2 PERCENT EERS WILL LOWER LONG-TERM RATES

Virginians pay not only base rates, but also a variety of RACs to cover an array of past and ongoing investment to meet total energy system needs. Efficiency programs must be paid for as well and are therefore no different. However, even when including the small increase in customer RAC costs to cover upfront efficiency implementation, energy efficiency is the least-cost resource when compared to other RAC and base rate expenses. Thus, efficiency lowers total rates in the long term, when compared to alternate investment in increasing new generation or shoring up transmission and distribution. The figure below is from Dominion's IRP and shows the cost of its energy efficiency programs compared to supply-side options.

[57] National Grid, n.d. "2019 Bill Impacts." http://rieermc.ri.gov/wp-content/uploads/2018/09/2019-eepp-attachment-7-bill-impact-analysis-final-draft.pdf.

[58] Tim Woolf et al. 2014. "Rate and Bill Impacts." https://www.synapse-energy.com/sites/default/files/SynapseReport.2014-04.VT-PSD.VT-EE-Bill-Impacts.13-088.pdf.

Figure 5.5.4.3 – Comparison of per MWh Costs of Selected Generation Resources

Comparison of per MWh Costs of Selected Generation Resources to Phase II through Phase VI Programs	
Utility Cost Perspective	**Cost ($/MWh)**
Non-Residential Heating and Cooling Efficiency Program	$5.47
Residential Retail LED Lighting Program (NC Only)	$14.70
Non-Residential Lighting Systems and Controls Program	$14.72
Non-Residential Window Film Program	$19.79
Non-Residential Prescriptive Program	$33.12
Solar	$56.38
Small Business Improvement Program	$56.51
2X1 CC	$67.72
1X1 CC	$78.44
Onshore Wind	$94.10
CT	$107.05
Offshore Wind	$130.60
Nuclear	$141.52
Aero CT	$171.54
Fuel Cell	$199.25
Biomass	$221.08
Income and Age Qualifying Home Improvement Program	$237.17
Solar & Aero CT	$248.73
SCPC w/ CCS	$309.93
IGCC w/ CCS	$444.91
CVOW	$779.71

Figure 5. Comparison of per MWh Costs of Selected Generation Resources.

Even the cheapest supply side option, solar, at $56.38 per MWh, is still nearly 50 percent higher than that of the most expensive energy efficiency option. The lowest-cost dispatchable resource – the gas combined cycle plant, costing between $67.72 per MWh and $78.44 per MWh – is 2 to 10 times the price of the costliest energy efficiency option. Virginia's over-emphasis on costlier generation spending is notable: in the past decade alone, Dominion has invested ratepayer dollars in at least 10 supply-side power plants that total nearly 6 GW of capacity, at a cost to Virginia customers of over $6 billion.[59] Over the medium to long term, increased energy efficiency could have supplanted the need for even more expensive supply-side builds that Virginia has invested in so heavily, and led instead to lower overall revenue requirements for Virginia utilities.

Energy efficiency also delivers other benefits to all ratepayers, both participants and non-participants. Efficiency reduces peak demand, decreasing the dispatch of high-cost (and higher polluting) marginal generators, which also lowers the market clearing cost for electricity. While the specific benefits of this effect can vary widely by location, Massachusetts has saved upwards of $700 million from these price suppression effects.[60]

Energy efficiency also reduces the need for expensive upgrades to an overstressed transmission and distribution system. While these costs are also highly location-specific, energy efficiency programs in Massachusetts have saved $423 million in avoided transmission and

[59] The plant investments include Altavista, Bear Garden, Bremo, Brunswick, Greensville, Hopewell, North Anna 3, Southampton, Warren, and VCHEC.

[60] Tim Woolf, 2013. "Energy Efficiency: Rate, Bill and Participation Impacts." https://aceee.org/files/pdf/conferences/eer/2013/5C-Woolf.pdf.

distribution costs.[61] In addition to bill savings, these are the larger system cost savings that Virginia has left untapped, and which an EERS would help deliver.

A 2 PERCENT EERS WILL SIGNIFICANTLY CONTRIBUTE TO VIRGINIA'S CARBON GOALS

Efficiency savings also directly reduce upstream power plant pollution, making an EERS a useful tool for Virginia's own environmental and climate change goals. To address climate change, Virginia requires a 30 percent reduction by 2030 in the carbon pollution from in-state power plants: our analysis suggests an EERS could deliver 35 percent of that target.

In April 2019, the Virginia State Air Pollution Control Board finalized a regulation that requires large fossil-fuel electric power plants to annually reduce CO_2 emissions.[62] The regulation puts an initial 28-million ton cap on total CO_2 emissions from large plants, and mandates a reduction of 30 percent by 2030. A 2 percent EERS is a low-cost, proven way to make strong progress toward this significant statewide emission reduction. This section shows how an EERS would likely impact carbon emissions in the Commonwealth.

Virginia's 2030 carbon limit will be applied to an inefficient electric system, with rising consumption and its associated carbon pollution. The final regulation sets an initial 2020 carbon emissions cap of 28 million tons for large in-state generators (compared to expected emissions of 28.02 million tons).[63] The electric load is expected to increase over the next decade which, in the base case, will further increase emissions.[64] In order to isolate the impacts of the EERS, this analysis assumes that the Virginia emissions rates will remain constant over the period in question (i.e., that emissions will not change from differences in generation mix, in addition to the lower overall energy usage as a result of the EERS).

As shown in Figure 3 above, a 2 percent EERS will eliminate and then reduce electric load growth, thus reducing the associated upstream carbon emissions. In addition, energy efficiency reduces the use of marginal, highest-cost generators, which tend to be the most carbon intensive form of electricity production, typically older and less efficient coal and oil units. Modeling by Natural Resources Defense Council (NRDC), conducted by ICF, projected that the CO_2 emissions intensity of Virginia grid energy would be around 0.29 tons per MWh. However, in electricity generation, the low- and no-carbon sources tend to be used as baseload, with the higher carbon sources used at the margin. Since energy efficiency lowers emissions at the margin, the impacted electricity has a higher emissions factor than the average electricity - estimated at 0.42 tons per MWh by Bloomberg New Energy Finance (BNEF).[65] This means that a 2 percent EERS will actually result in greater than 2 percent annual incremental reductions in carbon emissions.

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[61] Id.

[62] Virginia Department of Environmental Quality, 2019. "Virginia Adopts Regulation to Limit Carbon Pollution, Fight Climate Change," April 19. https://www.deq.virginia.gov/ConnectWithDEQ/NewsReleases/CarbonRule.aspx.

[63] NRDC Modeling of a Virginia Base Case, conducted on behalf of NRDC by ICF using their Integrated Planning Model (IPM) modeling for 2020. March 2018.

[64] Increase in electric load is based on data in the Dominion and APCo IRPs.

[65] Bloomberg New Energy Finance, 2019. US Power and Fuel Prices.

A 2 percent EERS can achieve a significant portion of Virginia's carbon target by directly reducing upstream smokestack carbon emissions. Figure 4 shows carbon emissions from Virginia electricity generation in the baseline case of no efficiency, compared to a 2 percent EERS. The baseline case uses a constant 2020 average emissions factor and projects load growth based on the Dominion and APCo IRP forecasts. The efficient case uses the BNEF 2020 estimate for the marginal emissions rate applied to the savings from the 2 percent EERS. We assume, conservatively, that energy efficiency will reduce electric imports to Virginia in proportion to the total imports. In other words, since about 20 percent of Virginia sales are from out-of-state power imports, we assume that only 80 percent of the total efficiency savings from the EERS will go towards reducing in-state emissions from utility scale generators.[66] The figure below also shows Virginia's declining carbon limit.

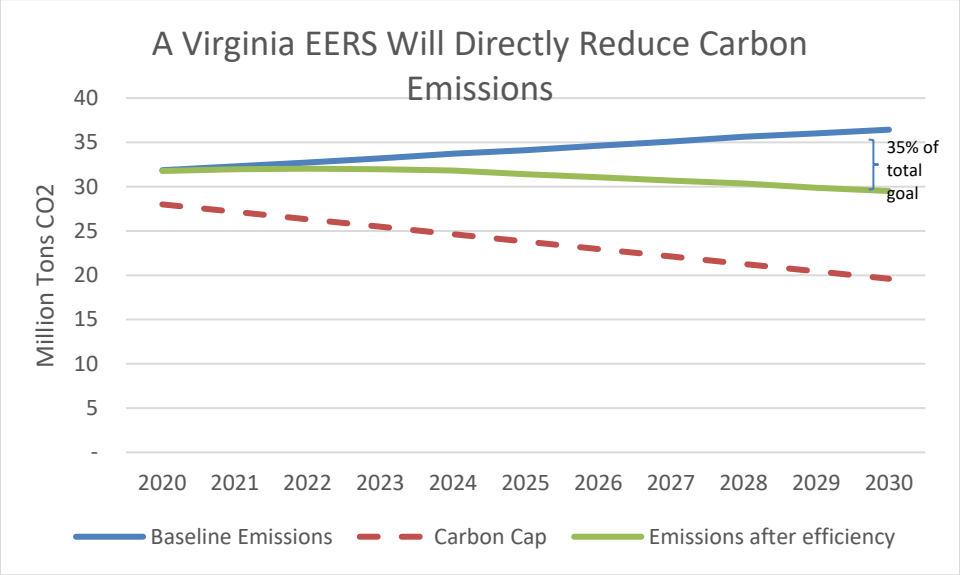

Figure 6. Projected CO2 reductions from 2 percent EERS compared to the baseline forecast and the statewide carbon budget.

Compared to an increase in emissions of 11 percent in the base case with no EERS, emissions under an EERS would fall by 4 percent. An EERS would therefore achieve 35 percent of the 2030 carbon reduction goal, when compared to a base case of rising electric consumption and rising emissions. This carbon reduction is to be expected. Studies evaluating economy-wide decarbonization regularly point to energy efficiency as the most cost-effective approach to achieving meaningful greenhouse gas emissions reductions.[67] In fact, while many emissions reductions strategies, like increased renewable deployment, come at a net cost, energy efficiency is shown to instead deliver significant net savings. For this reason, energy efficiency should be Virginia's first strategy deployed to reduce carbon emissions in the near and long term.

[66] EIA data show approximately 22 percent of Virginia electricity from imports and combined heat and power (CHP). EIA, 2019. "Virginia Electricity Profile 2017," in *State Electricity Profiles*. https://www.eia.gov/electricity/state/Virginia/.

[67] McKinsey & Co., n.d. "Pathways to a Low-Carbon Economy: Version 2 of the Global Greenhouse Gas Abatement Cost Curve." https://www.cbd.int/financial/doc/Pathwaystoalowcarboneconomy.pdf.

HIGH LEVELS OF ELECTRIC HEATING GIVE VIRGINIA A SPECIAL EFFICIENCY OPPORTUNITY

Virginia is better positioned than most jurisdictions to pursue energy efficiency savings via an EERS in the residential sector: Virginia households are highly electrified (i.e., higher levels of electric heat and hot water, as opposed to use of natural gas or fuel oil). Those electrified end uses provide more opportunities for significant electric efficiency programs and savings than in many other states.

This is particularly true for Virginia's residential home heating. A full 55 percent of Virginia homes use electricity as the primary heat source, and about 60 percent of those homes use electric resistance heating.[68,69] Electric resistance heating is notoriously wasteful, inefficient, and obsolete. Converting to air source heat pumps, a common and well-established technology, could reduce heating costs by more than 60 percent.[70] The savings are not limited to heating. Air source heat pumps provide cooling in the summer as well, and are typically more efficient than central air conditioners. Therefore, air source heat pump conversions deliver additional cooling savings and peak demand reductions as well.

According to the Mid-Atlantic Technical Reference Manual (TRM), a typical 2-ton electric resistance heating system in Virginia will use 6,600 kWh in the heating season. Converting to a heat pump reduces this to 2,700 kWh, a savings of 3,900 kWh. This represents under a 3.5-year simple payback on the full cost for a new heat pump for a customer, even before any utility efficiency program incentives or cooling savings are included.[71]

If just half of the Virginia households with electric resistance heat converted to heat pumps under a utility efficiency program, Virginia's total residential load alone would decrease by almost 4 percent.[72]A similar analysis applies to converting inefficient electric resistance water heaters to heat pump water heaters, which can use 60 – 70 percent less electricity.

In both cases, Virginia's high saturation of electric heating equipment (as opposed to gas and oil) gives Virginia a large, highly cost-effective opportunity for savings.

We recommend that part of the energy efficiency portfolio for Dominion and APCo under an EERS include programs that aggressively promote replacement of highly inefficient and costly electric resistance heat with air source heat pumps, as well as heat pump water heater upgrades.

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[68] EIA, 2009. "Household Energy Use in Virginia." https://www.eia.gov/consumption/residential/reports/2009/state_briefs/pdf/VA.pdf.

[69] EIA, 2016. "2015 RECS Survey Data," in *Residential Energy Consumption Survey (RECS)*: Table HC6.8: Space Heating in the South and West Regions. https://www.eia.gov/consumption/residential/data/2015/hc/php/hc6.8.php.

[70] For Virginia-specific assumptions from EIA data, see NEEP, 2018. "Mid-Atlantic Technical Reference Manual, Version 8," May. Lexington, Mass.: Northeast Energy Efficiency Partnerships. https://neep.org/sites/default/files/resources/Mid_Atlantic_TRM_V8_0.pdf.

[71] Costs and Full Load Hours from Mid-Atlantic TRM. See NEEP, 2018. "Mid-Atlantic Technical Reference Manual, Version 8," May. Lexington, Mass.: Northeast Energy Efficiency Partnerships. https://neep.org/sites/default/files/resources/Mid_Atlantic_TRM_V8_0.pdf.

[72] Calculated as 55 percent of homes with electricity as their primary heat source, times 60 percent of these homes using electric resistance, times 32 percent space heating as percent of total electric use (RECS), times 70 percent savings from heat pumps, times 50 percent penetration.

TWO PERCENT SAVINGS WILL REQUIRE STRONG PROGRAM DESIGN

Achieving 2 percent savings will require well-designed programs operating in every market. Dominion's recently approved phase VII DSM plan contains 11 programs:

- Residential Appliance Recycling Program
- Residential Customer Engagement Program
- Residential Efficient Products Marketplace Program
- Residential Home Energy Assessment Program
- Residential Smart Thermostat Management Program – Energy Efficiency
- Residential Smart Thermostat Management Program – Demand Response
- Non-Residential Lighting System & Controls Program
- Non-Residential Heating and Cooling Efficiency Program
- Non-Residential Window Film Program
- Non-Residential Small Manufacturing Program
- Non-Residential Office Program

This section identifies several additional areas that would significantly improve and expand Dominion's efficiency portfolio to facilitate achievement of a 2 percent EERS.

- **Residential and Non-Residential New Construction –** The incremental cost of new construction efficiency measures tends to be lower than when retrofitting existing buildings. If savings are not captured at construction, it will be decades before some of the building systems are replaced. Successful utility programs targeting new construction typically use a multi-pronged approach to ensure architects, engineers, and developers integrate efficiency throughout the design and build process.

- **Low-Income Program –** The Commonwealth has recognized the vulnerability of low-income people to the state's rising electric costs. Virginia's Grid Modernization and Security Act requires that at least 5 percent of energy efficiency programs benefit low-income, elderly, or disabled people. To achieve this goal, it is likely necessary to design a program that specifically meets the needs of the low-income sector and that pays 100 percent of the cost of efficiency. We also recommend that the 5 percent level be substantially increased in any new legislation.

- **LED Streetlighting – High-efficiency** LED streetlights are sometimes more difficult to install via traditional programs, as they are often owned and operated by the utility or local governments. However, LED streetlights are an extremely cost-effective measure with potentially large financial savings, given their high numbers and constant use. Efficiency programs in other jurisdictions have addressed utility or locality-owned streetlights in ways that solve stranded asset concerns and ensure the utilities' best interest to pursue the most cost-effective street lighting solutions.

- **Residential and Non-Residential Upstream** - Upstream programs – where the incentive is given to the manufacturer, distributor, or retailer and automatically applied at purchase – significantly increase program participation and savings by working directly with manufacturers, distributors, and retailers to promote high efficiency equipment, including providing incentives to upstream manufacturers and distributors rather than to end users. The end-user customers do not need to file paperwork or otherwise actively enroll in a program; they just see a discounted product on the store shelf and may not even realize that they have just participated in an efficiency program. Further, since retail markups are usually based on a percentage of wholesale prices, by lowering the wholesale price of the product upstream, incentives can leverage lower program costs to reduce retail prices. Upstream market players are often best situated to promote efficient products to their customers and are necessarily involved at the appropriate time for installations, such as replacements at the time of equipment failure. Recent efforts in California, Massachusetts, and New Brunswick to move standard rebates for lighting and heating and cooling measures completely upstream (with distributors providing an incentive based on wholesale incremental cost for each unit sold) have been very successful.

- **Non-Residential Custom –** C&I customers have much more variation in size, load, and energy needs than residential customers. As a result, they often have custom needs that are difficult to address through simple prescriptive rebates. Successful commercial custom programs with high customer participation include important enhancements and complementary services focused on providing greater customer service and sometimes detailed technical assistance. Best-practice C&I custom programs include:
    - Active account management for medium and large customers
    - At the customer's request, the provision of tiered energy services starting with on-premise walk-through energy audits (ASHRAE tier I) at no or low cost
    - Assistance with streamlined delivery, including a single point of contact or bundled efficiency measures (retro-commissioning, building operator training, common area lighting, audits) for large buildings
    - Provision of detailed technical assistance and feasibility studies (ASHRAE tier II). Many utilities offer these services with an initial customer contribution of 50 percent of the cost. If the customer follows through with implementation of the resulting recommendations, this contribution is waived and the program covers 100 percent of the study. This strategy has been quite effective. Requiring an initial financial commitment reduces the number of customers who are not serious are about making efficiency investments; forgiving that cost creates a strong incentive for customers to implement identified measures
    - Turnkey project management that includes energy efficiency project identification; scoping and documentation services, such as assistance in filling out program materials; engaging with design professionals and contractors;

and generally helping to coordinate the participation and implementation process

- Maintaining a group of expert process engineers in various industrial processes. These can be referred to industrial clients to examine their industrial process energy usage for efficiency improvements. There are often many low / no cost process measures that can significantly reduce process-related energy use and cost

- **Non-Residential Small Business Direct Install** – This program is commonly offered as part of a full efficiency portfolio, to address specific barriers that make it hard for small businesses to participate. Small Business Direct Install programs typically offer a free energy assessment that recommends changes in lighting and other simple measures. The customer can choose which identified measures to implement, and the program pays a significant portion of the upfront cost, typically 50-75 percent. The turnkey program makes participation as easy as possible

PERFORMANCE INCENTIVES BETTER ALIGN UTILITY INCENTIVES TO PROMOTE EFFICIENCY

While efficiency program costs are recovered in Virginia through RACs, the fact that the utility earns a rate of return on larger investments in more expensive power plant options means utilities are more motivated to invest in generation than in efficiency. To equalize demand-side and supply-side resources, many states include performance incentives that provide extra financial benefits when efficiency programs meet certain goals. Currently, twenty-nine states have performance incentives. The exact form and conditions for performance incentives vary widely, but they are often in the range of 5-10 percent of program spending.[73] Performance incentives can be very successful at encouraging utilities to make energy efficiency a priority, as well as proposing higher savings targets.[74] A Virginia EERS should include such incentives.

[73] ACEEE, 2018. "Snapshot of Energy Efficiency Performance Incentives for Electric Utilities." Topic Brief, December. Washington, DC: ACEEE. https://aceee.org/sites/default/files/pims-121118.pdf.

[74] ACEEE, 2018. "Snapshot." https://aceee.org/sites/default/files/pims-121118.pdf.

CONCLUSION

In recent years, Virginia has seen significant increases in electric bills and rates (particularly RACs), with more increases expected. At the same time, energy efficiency – Virginia's lowest cost energy resource – is significantly underutilized. In 2017, only five states had lower efficiency savings than Virginia, and Virginia is projected to remain in the lowest quintile of states, even with its planned expansion of energy efficiency under the GTSA.

The current nonbinding targets set in 2007 have not delivered additional efficiency. Over a decade later, neither of Virginia's largest utilities are in range of meeting the targets, and Dominion will still be saving less than 50 percent of the target, even after its planned efficiency program expansion.

Clearly, a new approach is needed to provide Virginia ratepayers the full benefits of energy efficiency and relief from rising electric costs. The EERS is a tried and tested approach. Since Texas implemented the first EERS over two decades ago, 27 states have implemented them. EERSs have been highly successful: states with an EERS have average energy efficiency savings of 1.3 percent per year, compared to only 0.3 percent for states with no EERS.

Energy efficiency necessarily causes a short-term increase in RAC costs, as does any investment, but in the long-term, efficiency will lower the total cost of rates and RACs, as the need for more expensive supply-side investments is displaced. More immediately, efficiency delivers short-term reductions in average electric bills, as total energy usage is lowered beyond the cost of efficiency measures. While non-participants may see bill increases, this can be addressed by more comprehensive energy efficiency investment and better outreach and marketing to all customer segments. Under the 2 percent EERS proposed in this brief, efficiency programs would be broad enough to give every Virginia ratepayer multiple avenues to participate and lower bills.

A 2 percent EERS would also achieve over a third – 35 percent – of the carbon reductions necessary to meet Virginia's 2030 carbon reduction requirement. Further analysis would also quantify the significant additional benefits of mitigating fuel price increases, improving indoor and outdoor air quality across the Commonwealth, and increased local economic activity, both from bill savings and increased employment.

APPENDIX

ELECTRICITY SAVINGS BY STATE, 2018

The table below shows the most recent annual electricity savings as a percent of load for all jurisdictions with higher savings rates than Virginia.

Table 5. ACEEE 2018 net incremental electricity savings by state

State	EE savings as a percent of statewide load	State	EE savings as a percent of statewide load
Massachusetts	2.82%	Utah	0.70%
Rhode Island	2.79%	Arkansas	0.68%
Vermont†	2.30%	North Carolina	0.67%
Maryland	1.87%	Missouri	0.61%
Illinois	1.66%	Nevada†	0.59%
California†	1.62%	New Mexico	0.56%
Hawaii†*	1.47%	Indiana†	0.55%
Michigan	1.46%	Montana†	0.51%
Connecticut	1.37%	Oklahoma	0.50%
Minnesota†	1.33%	South Carolina†*	0.49%
Arizona†1	1.27%	New Jersey†	0.35%
District of Columbia	1.23%	Mississippi	0.28%
Washington†	1.18%	Nebraska†3	0.26%
New York†	1.16%	Georgia†	0.25%
Ohio†	1.14%	Wyoming†	0.24%
Iowa†2	1.08%	South Dakota†	0.20%
Colorado	1.07%	West Virginia	0.19%
Maine†	1.05%	Texas†	0.18%
Oregon†	0.95%	Delaware	0.15%
Idaho†	0.87%	Tennessee†	0.13%
New Hampshire†	0.75%	Kentucky†	0.12%
Pennsylvania†	0.74%	Florida†	0.09%
Wisconsin	0.72%	Louisiana†	0.05%
		Virginia	**0.05%**

ESTIMATING THE RAMP-UP PERIOD NECESSARY FOR 2 PERCENT EERS

To determine the ramp-up of costs and savings associated with a 2 percent EERS in Virginia, we looked at recent energy efficiency savings achieved by APCo and Dominion. We relied on recent evaluation results from both service territories to understand their positions. Evaluated results for 2013-2017 were filed as part of Dominion's 2017 DSM filing; APCo filed evaluated results for program year 2016 in its 2017 DSM filing. To calculate historic and projected savings

as a percent of sales, we used load forecasts from APCo and Dominion's most recently filed IRPs. We removed sales of opt-out customers from the sales forecast, assuming the same load percentage as calculated from Dominion's 2017 DSM filing. We note, however, that most states that allow large customers to opt-out of efficiency programs still require these customers to spend what they otherwise would have paid for the efficiency surcharge on cost-effective energy improvements in their own facilities.

Because the utilities' levels of savings are significantly lower than the 2 percent savings proposed as an EERS, a ramp-up period will likely be needed to reach that level of savings. We assumed a ramp-up period of approximately 0.35 percent per year for the utilities to reach 2 percent savings by 2025.

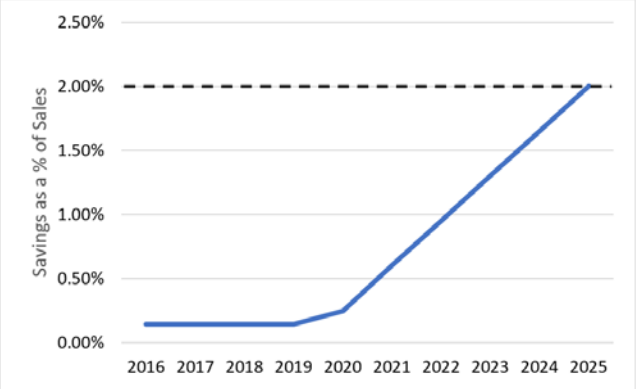

Figure 7. Potential 2 percent EERS savings ramp-up for Virginia.

PROGRAM PORTFOLIO MARKETS, TARGETS, AND CHARACTERISTICS

Residential

In successful energy efficiency program portfolios, residential program designs respond to the needs of homeowners and renters. All key savings opportunities from simple lighting improvements to whole-house retrofits are addressed through integrated and mutually supporting programs. These programs engage and motivate customers to participate by removing barriers and by offering technical support and financial incentives. Residential program strategies tend to fall into three primary categories: whole-house programs, efficient products, and behavior modification.

Whole-House Programs

Whole-house programs provide comprehensive energy upgrades, addressing all primary efficiency opportunities within a home. These involve improving insulation and reducing air leakage in walls, windows, and ceilings, and increasing the efficiency of the mechanical and electrical systems that heat and cool the indoor environment, heat water, and produce light, refrigeration, and other needs. A common feature of most effective whole-house programs is that they are fuel-neutral, addressing savings opportunities for electricity, gas, and / or bulk-delivered oil and propane. Moreover, they tend to provide services for both retrofit and new construction projects.

Retrofits. Whole-house retrofit programs usually involve a home energy audit and recommendations for energy-saving measures, along with financial incentives for implementing these recommendations.

New Construction. Residential new construction whole-house programs usually work with builders, contractors, architects, developers, code officials, and suppliers to promote the design and construction of efficient new homes. Similar to whole-house retrofit programs, successful new construction programs address all key end uses and building systems. Program incentives are usually tiered, with higher incentives available for greater levels of efficiency.

Multifamily. Providing comprehensive energy efficiency services to people who live in apartments can be difficult and is often overlooked by efficiency programs. At the root of this phenomenon is the split incentive problem, which is defined by the need for the owner to make an investment in building systems while the resident, who pays the energy bill, receives the benefit of reduced cost. (In other words, there is no payback to the owner.) The most successful multifamily programs comprehensively provide energy efficiency services, working with property owners, managers, and occupants to address the full spectrum of energy-saving opportunities.

Income-Eligible or Low-Income. Program administrators often offer programs specifically for income-eligible customers to reach those who might be unlikely or unable to participate in the residential programs described above. The goal of income-eligible programs is to assure that comprehensive efficiency services are provided to as many residents who need them as possible, regardless of their ability to afford them. The best income-eligible energy efficiency programs are deeply connected with local service providers delivering support to income-eligible people. Services might involve comprehensive energy audits and full-cost incentives for improvements related to building shell improvements, heating and cooling system efficiency improvement, appliance efficiency improvements, water heating efficiency improvements, and lighting efficiency improvements.

Efficient Products

Efficient products programs work with manufacturers and retailers to promote the stocking, marketing, and sale of efficient residential lighting, appliances, consumer electronics, domestic hot water equipment, and heating, ventilation, and air conditioning equipment to consumers. Efficient products programs complement whole-house programs by optimizing the efficiency of products that residential customers buy through contractors, or which are sold to them directly by retailers. These programs can provide financial incentives in the form of either traditional customer rebates or upstream buydowns.

Behavior Modification

Many residential portfolios also involve behavior programs. Although behavior programs are sometimes considered whole-house programs, their approach differs from the financial incentive-based program models used for the other whole-house programs. Behavior programs typically provide home energy reports to customers, to motivate them to reduce their energy use through social norming and behavioral change.

Commercial & Industrial

The C&I sector is far more diverse than the residential sector, encompassing everything from a small, independent retail store to a large highly specialized industrial facility. Successful program portfolios often include three broad programs in the C&I sector. These align with the decision processes of this diverse array of customers.

The first distinction in the decision process for the C&I sector is between retrofit and lost opportunity. This distinction recognizes a fundamental difference in the economic calculus for evaluating efficiency projects as part of new construction or other replacement of existing equipment (scheduled or at failure), which are defined as lost opportunities. Retrofit projects, on the other hand, are when existing equipment is in working condition and the project is motivated primarily by the energy savings. The next distinction is between small and large customers. Each should be addressed by its own program. Each has a different profile relating to facility characteristics, equipment types, purchasing processes, financial situation, and owner familiarity with energy efficiency. Further, certain program approaches might not be cost-effective for both segments.

The portfolio of efficiency programs directed at the C&I sector often consists of large umbrella programs with several different strategies or initiatives aimed at capturing savings from different segments of this diverse group of customers. The section below discusses the major program strategies included in each of the umbrella programs.

Lost Opportunity

A lost opportunity program applies when the customer is already purchasing new equipment, and incentives might need to offset only part or all of the cost difference between standard equipment and efficient equipment. A program would focus on the incremental cost and savings available. Lost opportunity programs can cover all end uses and technologies that produce cost-effective energy savings, and encompasses many different delivery models and services. These programs usually involve design and technical assistance for new construction and replace-on-failure projects, standard prescriptive incentives, and upstream incentives for common lighting measures.

Large-Business Retrofit

Large-business retrofit programs capture energy savings from existing large C&I customers. These programs encourage early replacement of inefficient equipment before it stops working, adding or improving controls or sensors to lower the energy use of existing systems, and helping businesses improve operational practices and optimize systems to lower energy use. Large-business retrofit programs can cover all end uses and technologies that produce cost-effective energy savings and encompass many different delivery models and services. Similar to lost opportunity programs, large-business retrofit programs use delivery strategies such as account management, prescriptive incentives, custom incentives, and technical and design assistance.

Small-Business Retrofit

Small businesses are typically constrained by both staff time and financial resources. This makes it hard to invest the time and money in identifying and installing efficiency upgrades. Further, the small amount of per-customer energy use in this segment means that the program administrators cannot cost-effectively spend too much time on each facility. Small-business retrofit programs often address these problems by combining free on-site audits with high financial incentives and easy application processes to achieve significant savings from high efficiency lighting and other easy-to-install efficiency measures.

BENEFITS OF ENERGY EFFICIENCY BEYOND ENERGY SAVINGS

Risk Reduction

Because the largest part of the cost of producing electricity is fuel, electric prices are highly correlated to underlying fuel commodity prices, which can be highly volatile, leaving ratepayers exposed to price shocks. The costs of energy efficiency, by contrast, are largely local labor and expenses, which can be ramped up and down more easily, and are much less exposed to the ups and downs of the global commodity markets.

Another type of risk relates to the construction of new generation facilities. These facilities may take 10 years or longer to begin producing power and are more exposed to unexpected capital cost overruns. Some states quantify the value of reduced risk from efficiency and include it as a benefit in cost-effectiveness testing. Vermont, for example, adds 10 percent to the benefits of avoided energy and capacity as a proxy for this risk reduction. However, this practice is still fairly rare.

Transmission and Distribution Avoidance

In addition to peak demand savings from avoided generation, there are often additional savings from lowering the load on the transmission and distribution system. These savings can be significant, but they are highly variable from jurisdiction to jurisdiction and difficult to estimate without a dedicated study.

Demand Reduction Induced Price Effects

Many states, especially in New England, are beginning to recognize demand reduction induced price effects (DRIPE) as a quantifiable benefit of energy efficiency and demand response. DRIPE is a measurement of the value efficiency provides by reducing the wholesale energy prices borne by all retail customers. The reduced energy demand due to efficiency programs removes the most expensive marginal generating resources and lowers the overall costs of energy. This reduces the wholesale prices of energy and demand, and this reduction is, in theory, passed on to retail customers. The effects on energy prices are small in terms of percentages, but the absolute dollar impacts are significant because the price reduction applies to all energy usage on the system.

Originally, it was thought that DRIPE would only be significant in the short-term. In the long run, market actors would react to lower energy consumption and peak demand by retiring inefficient generators. With lower available supply, wholesale prices would begin to increase again, assuming no other changes in demand. However, the most recent study on avoided costs in New England concluded that DRIPE impacts persist far longer than had been assumed. DRIPE effects in New England are now estimated to last 11 years for peak capacity reductions and 13 years for energy reductions. The value of DRIPE varies based on energy period and region, but for New England range from $0.001 per kWh to $0.032 per kWh and from $2.23 per kW to $59.07 per kW for peak demand.

Economic Development Benefits

There is a large and growing body of evidence that money spent on energy efficiency creates more jobs and provides a greater stimulus to local economies than equivalent money spent on supply-side resources. Efficiency investments are far more labor intensive than supply-side resources and require significant effort from contractors, design professionals, and suppliers and distributors. Academic research and interviews with business owners from process evaluations confirm that utility-run efficiency programs can be an enormous boon for small and local businesses. According to 2009 study done by the University of Massachusetts, Amherst, a $1 million investment in supply-side resources will create 5.3 jobs, while an equivalent investment in efficiency can be expected to create 16.7 jobs.[75] The table below shows estimates of the jobs effect of efficiency spending.[76] The multipliers are based on modeling by ACEEE, with multipliers adapted from a regional economic modeling tool. Typically, studies have found that around 10-20 net jobs are created per million dollars spent on efficiency.

Table 6. Effect of efficiency spending on jobs[77]

Spending Category	Impact	Amount (Millions)	Job Multiplier	Job Impact (job-years)
Installation	Upfront payment for efficiency measures	$100	13	1,300
Consumer spending	Because of efficiency spending, consumers spend less in the short term	-$100	12	-1,200
Consumer savings	Because of energy savings, consumers spend more in the long term	$200	12	2,400
Lost utility revenues	Utility revenues decrease because of energy savings	-$200	5	-1,000
Net effect of a $100 million investment in efficiency measures				**1,500**

[75] Throughout the report, one job represents one full-time job for one year.

[76] ACEEE. *Potential for Energy Efficiency, Demand Response, And Onsite Solar Energy in Pennsylvania.* April 2009.

[77] This study uses the same job multiplier as was found in the Pennsylvania ACEEE study, or 15 jobs per million dollars spent. This number is actually on the low side of multipliers found in the economic literature. When this paper references jobs created, it is referring to a job as one full time job for one year.

In addition to direct job benefits, one dollar of efficiency spending creates more than one dollar of economic activity. In economics, this is known as the multiplier effect. While every economic activity has some multiplier, the multiplier for efficiency spending is larger than that of many other activities, particularly compared with supply-side spending. The efficiency multiplier occurs as 1) people who are employed due to the efficiency program re-spend their new income in the economy; 2) increased demand for efficient products causes increased demand for upstream suppliers; and, 3) money saved by ratepayers from lower energy bills is spent on other goods and services.

These estimates have been validated by economic studies of specific investment decisions. For example, a 2009 study in East Kentucky found that efficiency investment of $634.2 million would create $1.2 billion of local economic activity and over 5,400 jobs, not including the effect of energy savings being reinvested into the local economy. A coal plant to produce the equivalent amount of energy would not only be more expensive, but would create only 700 jobs during the 3-year construction phase and 60 positions once operational.[78]

Health Benefits

Air pollution – such as sulfur dioxide, nitrogen oxides, and particulate matter emitted during electricity generation – causes health effects that damage both public well-being and the economy. Adverse effects include increased incidences of asthma, respiratory, and cardiac diseases; higher mortality rates; and increased medical and hospitalization spending. In fact, there is reason to believe that increased health costs due to air emissions effectively double the price of coal-fired electricity. A recent study from Harvard University finds that adverse health impacts from coal generation cost the public an average of 9.3 cents per kWh of power generated.[79,80] A study for the European Union estimates direct externalities at between 4 and 15 euro cents per kWh for coal generation, between 3 and 11 euro cents per kWh for oil, and between 1 and 3 cents per kWh for gas, consistent with the Harvard study.[81] Another study found that Ontario's electric generation produces 668 premature deaths, 928 extra hospital admissions, 1,100 extra emergency room visits, and 333,600 minor illnesses. The financial impact of these health effects is estimated to be over $3 billion per year. The study estimates total Ontario consumption at 26.6 Terawatt hours (TWh) per year, implying health costs for Ontario of over $0.11 per kWh.

Additionally, there is mounting evidence that, beyond these large-scale effects from generation, there is another set of health benefits at the building level. The effects of efficiency improvements to homes has a variety of health benefits to the residents, with documentation now including reduction in asthma, chronic obstructive pulmonary disease (COPD), and many other chronic health conditions. The health benefits are even greater when the efficiency measures are installed in low-income households.

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[78] Ochs Center for Metropolitan Studies 2009. "An Analysis of the Economic Impact of Energy Efficiency and Renewable Energy in the East Kentucky Power Cooperative Region." https://grist.files.wordpress.com/2010/11/ekpcgreenjobsreport.pdf.

[79] This is an average. The actual value varies widely from plant to plant based on its age, type of pollution controls, and downwind population.

[80] Epstein et al. Page 86. Full Accounting for the Life Cycle of Coal. http://www.coaltrainfacts.org/docs/epstein_full-cost-of-coal.pdf.

[81] European Commission Page 13. External Costs. http://www.externe.info/externe_2006/externpr.pdf.

Environmental Benefits

In addition to the health effects discussed above, emissions from electricity generation carry significant environmental costs. Although environmental damage can be very difficult to quantify, it can be avoided by investing in efficiency rather than traditional supply-side resources.

- Surface water and soil acidification
- Damage to vegetation and forests
- Contributions to coastal eutrophication, causing algal blooms, depletion of dissolved oxygen, changes in biodiversity, and losses in the tourism / fishing industry
- Faster weathering of buildings
- Reduced visibility from smog and haze
- Mercury accumulation in fish

Other Benefits

Efficient buildings tend to have smaller temperature swings, better lighting levels, less glare, lower temperature gradients, and better indoor air quality than standard buildings. These additional benefits partly improve participant comfort and quality of life, but may also manifest as decreased illnesses and increased worker productivity, which can translate into additional economic benefits. The links between buildings and occupant health and productivity are very complex and difficult to generalize. The Center for Building Performance Diagnostics at Carnegie Mellon University has created a database of studies that have attempted to quantify this link. Overall, it finds that building environments that are associated with efficiency, such as increased outside air circulation, individual control of lights, moisture control, and pollutant source controls reduce symptoms of illnesses such as flu, asthma, sick building syndrome, and headaches an average of 43 percent. Other measures, such as window views, natural ventilation, and increased day-lighting reduce symptoms by an average of 36 percent. Further, the studies find that lighting measures in offices increase worker productivity by a median of 3.2 percent. These estimates are highly uncertain, and the past efforts to quantify the benefits have found a range of from less than $10 to $50 per square foot over 20 years. Since the energy savings over 20 years for a typical LEED-certified building are about $10 per square foot, even the low range of this estimate would mean that health and productivity benefits equal the energy saving benefits of green buildings.[82]

[82] Kats, Greg, 2009. *Greening Our Built World.* Washington, DC: Island Press. https://islandpress.org/books/greening-our-built-world.