REDUCING HIGH LEVELS OF ENERGY BURDEN AMONGST LOW-INCOME VIRGINIANS LIVING IN MULTI-FAMILY HOUSING

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FRANK BATTEN SCHOOL of LEADERSHIP and PUBLIC POLICY

Contents

Disclaimer

The author conducted this study as part of the program of professional education at the Frank Batten School of Leadership and Public Policy, University of Virginia. This paper is submitted in partial fulfillment of the course requirements for the Master of Public Policy degree. The judgments and conclusions are solely those of the author, and are not necessarily endorsed by the Batten School, by the University of Virginia, or by any other agency.

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Executive Summary

This report addresses the significant challenge of energy burden among low-income households in Virginia, particularly those in multifamily housing. Despite state, utility, and federal initiatives, approximately 700,000 low-income Virginians spend more than 6 percent of their income on energy costs. These households, on average, allocate a greater share of their income to energy bills than higher-income families, forcing trade-offs on essentials like food and healthcare and perpetuating financial instability. This report examines the current landscape of energy burden in Virginia, outlines the limitations of existing utility-administered energy efficiency programs, discusses affordable housing programs operating in the state, and identifies unique barriers to efficiency program participation in multifamily housing, such as split incentives and financing constraints. The report then explores several viable solutions to these challenges, including on-bill financing models, concierge-style energy services to streamline access to technical and financial resources for property owners, and integrated efficiency and solar programs. By utilizing the criteria of cost, effectiveness, and feasibility, the report analyzes the pros and cons of three pilot programs designed to be implemented at the state level in Virginia, and provides recommendations for implementation considerations to Virginia Legislators and members of Virginia Energy, the state agency most likely to implement government programs that address demand- and supply-side energy issues in Virginia. After the analysis of alternatives and implementation considerations for each, such as to how to ensure that efficiency improvements are captured by savings for low-income households and not eliminated through subsequent rent increases by landlords, the report recommends that the Virginia General Assembly passes a bill authorizing Virginia Energy to administer an energy concierge pilot program, as this is the most politically and administratively feasible option of the three potential alternatives.

Problem Statement

Despite existing federal, state, and utility programs, and the recent availability of significant federal funding from the Inflation Reduction Act, too many low-income Virginians (about 700,000 households (Gibre and Jones, 2023)), especially those living in multifamily residences, do not benefit from existing programs and continue to face high energy burdens**.** This forces households to make difficult tradeoffs with purchasing necessities like food and healthcare, increases their rates of rent delinquency and evictions, and hampers their ability to save money and accrue wealth, contributing to a cycle of poverty. This problem affects low-income households disproportionately, as they are more likely to live in multifamily buildings with fewer options to reduce their energy use, leading them to spend a higher proportion of their income on energy utilities than any other income bracket.

Client Overview

The American Council for an Energy-Efficient Economy (ACEEE) is a US-based non-profit organization and one of the foremost research organizations for energy policy solutions in the country. ACEEE's mission is to support the transformation of the American economy's energy use to make it more efficient, equitable, carbon-neutral, and cost-effective ("About Us", n.d.). The organization holds a longstanding demonstrated interest in the topic of study; ACEEE has published a significant and extensive body of research about combatting the high energy burden amongst low-income households and is currently carrying out its Multifamily Energy Savings Project, a multi-year project aimed at expanding energy improvements for market-rate and affordable housing multifamily properties ("The Multifamily Energy Savings Project", n.d.). While primarily maintaining a national focus, as a thought leader in energy policy, ACEEE's work is in part driven by federal, state, and local governments requesting that research be conducted on specific issues of interest to those agencies. One such organization is the Virginia Department of Energy, one of the primary stakeholders for whom the recommendations resulting from this research will be made. ACEEE may opt to share the key work products of this research with its stakeholders, including those interested in learning about solutions to multifamily energy efficiency adoption, both in Virginia and across other states.

Consequences of High Energy Burden

Instances of high energy burden occur throughout the state of Virginia, where low-income households spend an average of 14 percent of their income on energy costs, compared to 4 percent for middle-income families, and rates are higher for black and Hispanic households than other groups (Gajadhar-Smith, 2024; "LEAD Tool, n.d."). High energy burden therefore disproportionately impacts low-income individuals, and homes with high energy burdens are often forced to forego basic necessities (Hernández and Leal, 2021), and on average experience worse health outcomes (Lima et al, 2022). By making it more difficult to save money and accrue wealth, and by adding to financial and emotional stress, the high energy burden also contributes to the cycle of poverty experienced by low-income households (Bohr and McCreery, 2019). As outlined in the Root Cause Analysis found in **Figure 1**, a variety of issues contribute to the problem of disproportionately high energy burden. The primary root cause of the high energy burden amongst low-income Virginians discussed in this report is limited investment in energy efficiency upgrades in multifamily housing in the state.

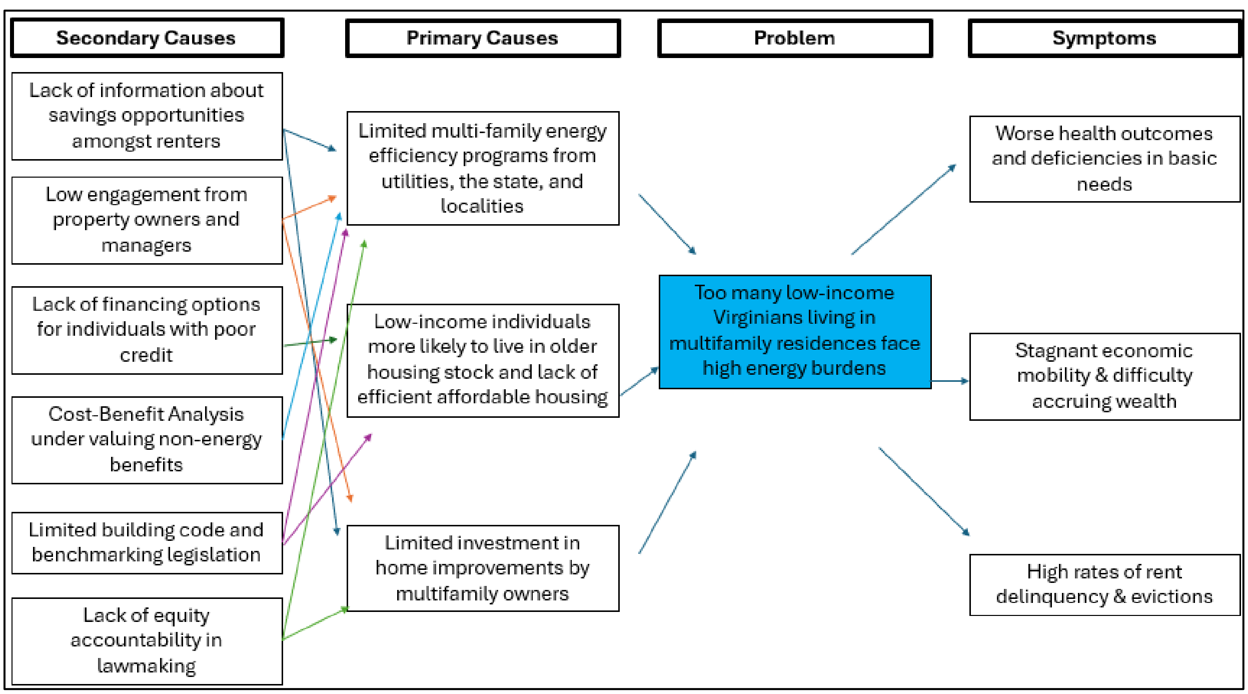

Figure 1: Root Cause Analysis

Background

High Energy Burden in Virginia

"Energy Burden" refers to the proportion of a household's income that is spent on energy utility bills. Households that spend six percent or more of their income are considered "high energy burden households" ("Low-Income Energy Affordability Data (LEAD) Tool", n.d.). As of 2020, U.S. households spent an average of 3.1 percent of income on home energy bills, while low-income households spent nearly three times that amount, at about 8.1 percent of income (Drehobl et al, 2020). Additionally, a quarter of low-income households in the US have energy burdens of at least 15.2 percent, with some areas reaching median energy burdens higher than 30 percent ("Data Update: City Energy Burdens", 2024; "Low-Income Energy Affordability Data (LEAD) Tool", n.d.). **Figure 2** shows the average energy burden by census tract for households in Virginia with incomes below 80 percent of the Area Median Income (AMI).

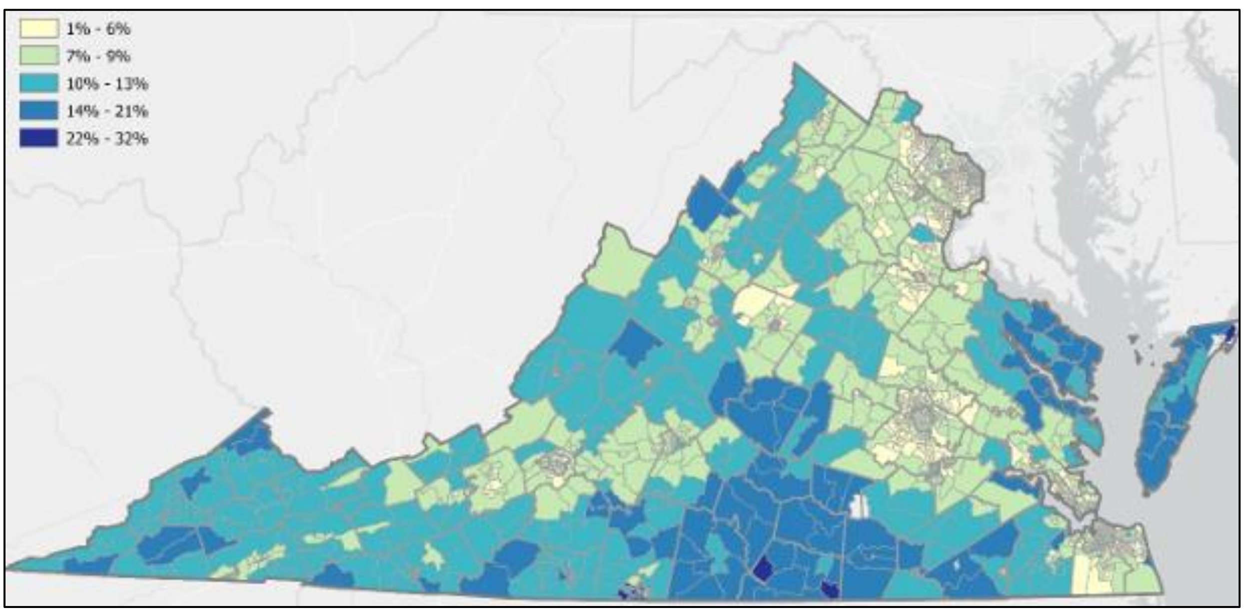

Figure 2: Map of Average Energy Burden of Low-Income Households by Census Tract (Pitt et al, 2023)

Existing Strategies: Utility-Administered Energy Efficiency Programs

Regulated utilities have been administering energy efficiency and other demand-side management programs for decades, first in response to the energy crisis of the 1970s, and then as required by a variety of policy and funding mechanisms such as energy efficiency resource standards and ratepayer-funded programs (York et al, 2012). Multifamily energy efficiency programs tend to fall under one of three categorizations: direct installations of no-cost measures (such as efficient lighting, weather sealing, and shower aerators); rebates for more substantial upgrades of efficient HVAC equipment, appliances, insulation, and water heating; and whole-building programs (either new construction or retrofit applications) (Johnson, 2023). Many utilities and state governments also administer low-income-specific programs, which restrict participation based on the income qualifications of the building's tenants and often provide higher incentives (Johnson, 2023).

In Virginia, the two largest investor-owned utilities are Dominion Energy and Appalachian Power, which serve 2.7 million and 530,000 Virginians, respectively ("Economic Development – Virginia", n.d.; "Virginia Economic Development", n.d.). Both utilities currently administer programs for multifamily customers who pursue energy audits and/or install efficient equipment ("Residential Multifamily Program", n.d.; "TakeCharge VA"*,* n.d.). Virginia Energy (formerly known as the Virginia Department of Energy) also administers a variety of programs meant to support the energy efficiency of multifamily properties through its State Energy Office. The Commercial Property Assessed Clean Energy (C-PACE) program helps multifamily building owners finance energy efficiency upgrades and other types of property improvements ("PACE", n.d.). Virginia Energy may also administer two residential-focused energy efficiency and electrification programs beginning in 2025, the Home Efficiency Rebate Program and Home Electrification and Appliance Rebates, which will receive about $190 million of federal funding from the Inflation Reduction Act. Only low- and moderate-income Virginians will be eligible for this program, and multifamily residences will be eligible ("Home Energy Rebates FAQs", 2024). These programs are one of several federally funded energy-related programs which are currently frozen as a result of an executive order by President Trump to halt provisions of the Inflation Reduction Act ("Freeze on 'Solar for All' State Grants Leave Virginia in the Dark", 2025), so it is uncertain when/if Virginia Energy will provide these programs in the future.

Lastly, the Virginia Department of Housing and Community Development (DHCD) is a state agency that partners with state, federal, local, and nonprofit housing and economic initiatives. Their mission includes preserving the affordability and efficiency of multifamily buildings in the state ("About DHCD", n.d.). DHCD works with its network of nonprofit implementors across the state to administer the federal Weatherization Assistance Program (WAP), a U.S. Department of Energy-funded program that provides income-eligible households with free efficiency improvements such as sealing air leaks, adding insulation, repairing or replacing heating and cooling systems, and installing energy-efficient lighting ("Weatherization Assistance Program (WAP)", n.d.). Between 2016 and 2019, an average of 1220 housing units in Virginia received WAP assistance each year ("Program Fact Sheet: Weatherization Assistance Program", 2021).

Challenges to Multifamily Energy Efficiency: Split Incentives and Investment

Several challenges exist to the development and participation in multifamily efficiency programs, but arguably the most critical is the problem of "split incentives"; a concept that refers to the idea that for multifamily properties, building owners are responsible for paying for the costs of energy upgrades, but the tenants receive the benefit of the investment, in the form of lower energy bills ("Low-Income Energy Affordability Data (LEAD) Tool", n.d.; Johnson, 2023). A 2018 study utilizing data from the 2009 Residential Energy Consumption Survey (RECS) implemented an OLS regression methodology, controlling for several covariates, and concluded that split incentives lead tenants to use approximately 2.7 percent more energy overall due to the landlord-tenant split incentive issue (Melvin, 2018). This issue is not as significant in master-metered buildings, where building owners pay for the entire building's utilities, and these costs are accounted for in tenants' rent (Ross et al, 2016).

The other primary barrier to the uptake of energy efficiency improvement programs in multifamily residences is a combination of time and resource constraints. Building owners and managers must manage a variety of priorities and may lack adequate staffing to take on energy efficiency projects or a lack of expertise to manage such technical projects, especially in the case of comprehensive whole-building retrofits (Ross et al, 2016; Samarripas and York, 2019). Further, building owners may lack sufficient capital to pay for the upfront cost of building upgrades (Johnson, 2023). They may also lack qualifying credit or for other reasons be unable to access financing for upgrades ("Low-Income Energy Affordability Data (LEAD) Tool", n.d.).

Types of Multifamily Affordable Housing

While the multifamily housing sector can be segmented in a variety of ways depending on the policy scenario (size/number of units, geography, rural vs. urban, etc.), it is most useful in a discussion of energy efficiency program uptake to think of the following three segments:

- Market rate housing, in which the rent is set by landlords, building owners, and managers and determined by market conditions;
- Subsidized affordable housing, in which the rent paid by occupants is subsidized by one of several U.S. Department of Housing and Urban Development (HUD) programs, through the federal Low-Income Housing Tax Credit, or another federal, state, or local government program; and
- Unsubsidized affordable housing, which is market-rate housing that is cheaper and therefore more affordable for low- and medium-income households.

Because this report focuses on *low-income* households living in multifamily housing, it is important to understand the distinct types of affordable housing programs in Virginia. The primary federal housing subsidy programs in Virginia are the Housing Choice Voucher Program (Section 8), Public Housing, Section 8 Project-Based Rental Assistance, and the Low-Income Housing Tax Credit (LIHTC). See Appendix XIII for additional details about affordable housing programs in Virginia.

Efficiency Program-Uptake Challenges in Affordable Housing

Affordable multifamily housing properties present unique barriers to energy efficiency adoption in addition to exacerbating the challenges described above. There is evidence that affordable units developed through low-income housing programs, which should be incentivized to higher quality due to government supervision and subsidies, are sometimes actually less energy efficient than similar unsubsidized properties (Kontokosta et al, 2020; Reina and Kontokosta, 2017). Whereas in market-rate housing, building owners can benefit from increased market values of units following energy improvements, in subsidized housing, fixed rent levels and prohibitions on rent escalations prevent building owners from obtaining that benefit (Fuerst et al, 2015; Reina and Kontokosta, 2017). As a more specific example, under the Section 8 Housing Choice Voucher program, the subsidies paid to building owners are meant to include an allowance for tenant-paid utility bills, so landlords are disincentivized from making energy improvements (Pennell et al, 2022; Pazuniak et al, 2015). An additional consequence is that tenants who live in less efficient units or use more energy than expected may incur bills that exceed their utility allowances (Ray et al, 2018).

Alternatives for Evaluation

This memo evaluates three potential policy alternatives the state of Virginia could pursue to decrease energy burden amongst low-income renters. A brief literature review providing background that led to the selection of these options is included in **Appendix 1**. The three policy options included in this analysis are as follows:

On-Bill Financing (OBF) Pilot Program

To overcome the issue of split incentives, which discourages multifamily building owners from investing in efficiency upgrades, the Virginia legislature could authorize Virginia Energy to administer an On-Bill Financing (OBF) pilot program, targeting installations of efficient equipment in 1,000 multifamily units. State-administered OBF programs for multifamily properties provide utilities with a way to fund energy efficiency upgrades without upfront costs to low-income tenants, allowing repayment through utility bills (Bianco and Sonvilla, 2021). These would occur only in individually metered buildings (as opposed to master-metered), where tenants are responsible for paying for their energy usage, therefore removing payment obligations from multifamily building owners/managers. In Virginia, this would involve Virginia Energy coordinating with utility companies and housing authorities and utilizing funding from the Virginia Clean Energy Innovation Bank (VCEIB) or another funding mechanism from Virginia Energy to provide low- or no-interest financing for installing efficient HVAC and water heating systems. The existing network of energy improvement contractors throughout the state that supports the federal Weatherization Assistance Program and other utility and state-administered efficiency improvement programs will complete the required energy audits and equipment installations. Loan repayment would occur as line items attached to meters in specific units that received improvements, tying repayment to current tenants rather than original leasers.

One-Stop Shop/Concierge Service Pilot Program

A key barrier to multifamily efficiency upgrades is a lack of knowledge about available capital and financing options (Olsthoorn et al., 2017; Schleich, 2004; Palmer et al., 2012). To address this, Virginia Energy could establish a "One-Stop Shop" (OSS)/Concierge service to assist building owners in navigating financing and technical assistance resources. The pilot program would seek to achieve building upgrades that impact 1,000 multifamily units occupied by low-income households. This service would provide comprehensive information about available funding and facilitate connections for building owners with stakeholders such as housing authorities, community action agencies, and economic development organizations (Samarripas and York, 2019). Beyond information provision, Virginia Energy would act as a concierge service, guiding building owners through application processes, ensuring compliance with protocols, and facilitating audits, installations, and access to financing, rebates, and tax credits.

Combine Comprehensive Retrofits with Solar Photovoltaic

Affordable multifamily housing providers increasingly find that combining efficiency upgrades with solar photovoltaic (PV) systems results in greater utility cost savings (Samarripas and York, 2018; Srivastava et al., 2020). In Virginia, Governor Youngkin established the Clean Energy Advisory Board to develop an Inflation Reduction Act-funded program offering loans and rebates for solar energy installations in low- and moderate-income households ("Clean Energy Advisory Board," n.d.). Although the program has not launched, the Board could require affordable multifamily owners to install efficiency upgrades before solar installations to maximize energy savings for low-income renters. Under the modified Solar-For-All program, multifamily building owner applicants would first be required to receive comprehensive energy audits and necessary efficiency improvements completed by certified contractors before receiving solar installations. The program would have a limited scope with the goal of 1,000 multifamily units receiving energy efficiency upgrades before the installation of the associated solar PV projects, to make it similar in scope to the other policy alternatives.

Criteria for Evaluation

The set of criteria by which these three policy alternatives will be evaluated is as follows. In this memo, each alternative will be ranked relative to one another on a scale of 1-3 (1 = best rating, 3 = worst rating), which will be informed by substantive projections on the outcomes of each alternative. The data and methodology used to estimate each alternative's performance will be included in the next section, as well as in the Appendix.

Effectiveness

Each of the alternatives should reduce the energy burden among low-income Virginians living in multifamily housing. I will utilize data about uptake for similar programs deployed in other states by utilities and state agencies and combine this with different sources' projections about energy savings (kWh) associated with the three different policy tools, to develop an estimate of kWh savings associated with each approach.

Cost

Each alternative will necessitate various direct and indirect costs for the relevant state agencies to design and implement. These costs will include investments in the Green Bank and other financing mechanisms (for the OBF alternative), staffing and LOE estimates for the state, and administrative costs of marketing the programs and coordination with stakeholders and utilities, etc. I will use data on implementation costs of similar programs in other states to project the cost associated with each alternative.

Feasibility

I will utilize my familiarity with Virginia's state politics, combined with conversations with stakeholders across the state's energy industry, to project the political and administrative feasibility of each alternative. Political feasibility refers to the extent to which required legislation or agency action for each alternative is viable, and the anticipated extent of buy-in from owners, tenants, and other stakeholders. Administrative feasibility refers to the capabilities of state agencies to coordinate with industry actors to effectively implement each alternative.

Analysis

Alternative 1: Administer an On-Bill Financing Pilot Program

Effectiveness

This policy alternative includes the Virginia State Legislature requiring Virginia Energy to develop and implement an On-Bill Financing (OBF) Pilot Program that provides capital for installations of energy efficiency heat pumps and heat pump water heaters in 1,000 low-income multifamily units. Pilot program designs provide several benefits for state and local governments seeking to improve energy efficiency, such as providing data and administrative lessons for wider scale adoption and creating opportunities to expand effective programs while limiting risk from wider-scope projects ("Effective Practices for Implementing Local Climate and Energy Programs", 2015). To estimate the effectiveness of this pilot, I utilized a report done in 2020 by the Southeast Energy Efficiency Alliance (SEEA) on four OBF programs administered by energy cooperatives in the Southeast, including in three states that neighbor Virginia. The programs included in the study vary in terms of their program design, but can all be included under the scope of On-Bill Financing. The programs include Ouachita Electric Cooperative's HELP PAYS® in Arkansas, Mountain Association Community Economic Development's How$mart® KY in Kentucky, Roanoke Electric Cooperative's Upgrade to $ave in North Carolina, and Appalachian Electric Cooperative's U-$ave Advantage in Tennessee. As local electric cooperatives operating in the same region as Virginia (except for Arkansas), data about these initiatives serve as effective models from which to draw inferences about the effectiveness of an OBF pilot program in Virginia at reducing energy usage. The SEEA report provides estimates of participation, average kWh savings/energy bill savings, and average tariff repayment on customers' utility bills for each program. By taking the average kWh savings associated with each of these programs, I estimate that annual savings for each project in Virginia's OBF pilot will be 6,964.89 kWh. I then multiplied the expected savings per project by the 1,000-household target established in the scope of the alternative to obtain an estimated annual energy savings of 6,964,890 kWh. **This alternative ranks 1st in terms of effectiveness.**

See Appendix II for additional assumptions, choices, and calculations included in generating this figure.

<u>Cost</u>

I limited the scope of the alternative's costs to those incurred by Virginia Energy in implementing the program, by homeowners participating in the program, and by building owners/managers who approve the projects in their buildings. Publicly available state government salary data yielded an average employee salary of Virginia Energy in 2023 of $69,506. Virginia Energy's involvement in implementing the program would be limited to coordinating with participating utilities on program design, facilitating connections between utilities, implementors, contractors, and building owners, as well as administering capital to participating utilities. I projected only one additional employee will need to be hired and compensated by Virginia Energy, based on an understanding that OBF programs may require multiple staff to implement ("How-to guide launching an On-Bill financing Program", 2017), but the implementation process in this case will primarily be the responsibility of the involved utilities, and because this pilot has a limited scope of 1,000 installations. To estimate how long the pilot would take to provide upgrades to 1,000 multifamily units, I utilized a report by the

Environmental and Energy Study Institute (EESI), Collaborative Efficiency (CE), and Michigan Saves that contained case studies about four existing OBF programs' participation statistics per year. The OBF programs detailed in the report include City of Tallahassee Utilities' Energy Efficiency Loans in Tennessee, Eugene Water and Electric Board (EWEB)'s Energy Efficiency Loan Program in Oregon, Central Electric Power Cooperative, Inc's Help My House Program in South Carolina, and Midwest Energy's How$mart Program in Kansas. While varying widely in financing mechanisms, scope, and geography, I used the programs as proxies for an OBF program in Virginia. I estimated that a small-scale OBF pilot would complete 1,000 projects over the course of 2.74 years. Staffing costs were therefore calculated at $195,313 when adjusting for inflation. I developed an estimate of capital costs equal to $8,000,000 by multiplying the 1,000-project target by an average cost per project of $8,000 (derived from a nationwide assessment of OBF programs conducted by the US EPA in 2016).

I also calculated the opportunity cost of participating in the program for tenants (using Virginia's minimum wage in 2025) as $124,100, and for building owners/managers (using an average hourly building manager salary in Virginia in 2025) as $164,350. I did not find any data about the time requirements of participation in OBF programs, so I developed these components of the calculations based on my best estimates of the time required for each activity involved in participation (e.g. being at home for energy audit and equipment installations, preparing application materials, reading terms of agreements, etc.). The total cost of this alternative is projected to be $8,195,313. **This alternative ranks 3rd in terms of cost.**

See Appendix III for additional assumptions, choices, and calculations included in generating this figure.

<u>Feasibility</u>

This program requires the General Assembly to pass a bill instructing Virginia Energy to implement a new OBF program. Virginia just passed a bill establishing a task force to improve access to energy efficiency programs for income-qualified households (*Virginia SB777*, n.d.). There is therefore a demonstrated interest amongst policymakers in investing in this policy goal, so a pilot program investigating one of the more commonly used policy designs should be highly feasible. There will be considerable overlap in priorities between Virginia Energy, state utilities, and other stakeholders in implementing an OBF program, including the need for utilities to file regulatory plans that receive state commission approval ("Driving Uptake for Energy Efficiency

Financing Programs", 2024). Utilities, especially Dominion Energy, have historically been powerful outside interests in their lobbying and campaign contributions in the state of Virginia, so a law that proposes additional administrative burden on the utilities may face strong pushback from utility stakeholders (Gobar, 2025). There are a wide range of best practice and program design materials published in the last two decades, as well as case studies about successful OBF program designs, and based on the implementation experience available to the utilities and Virginia Energy, I assume high administrative feasibility if this alternative is passed by the General Assembly. I assume that other stakeholders in the state, such as Virginia Housing, the Virginia Department of Housing and Community Development, and the state's efficiency contractor network would all support a pilot program: the amount of financing provided through OBF programs nationally continues to grow (Henner, 2020), and improvements to efficiency in low-income homes aligns with the missions of these organizations. Overall, because of the potential for utility opposition to the alternative, I assess it as having low political feasibility and high administrative feasibility. **This alternative ranks 2nd in terms of feasibility.**

Alternative 2: Administer an Energy Concierge Service Pilot Program

Effectiveness

Under this alternative, the Virginia General Assembly would require Virginia Energy to administer an energy concierge pilot program. Under this pilot, staff at Virginia Energy would connect affordable multifamily building owners and property managers with the wide array of energy efficiency improvement incentives and financing provided by utilities and state agencies that were discussed earlier in the report, with the goal of achieving building upgrades that impact 1,000 multifamily units occupied by low-income households. Case studies about energy concierge programs are limited as most utility programs include concierge services as a single component of a larger multifamily or commercial efficiency program. Further, I didn't identify any standalone concierge service program designs from which to draw data about kWh. However, a qualitative ACEEE report in 2017 describes several utility program approaches that are especially impactful for multifamily buildings. The report describes how one-stop shop/concierge services are included in the design of three efficiency programs, and also provides data about cumulative savings associated with these programs: Bay Area Regional Energy Network (BAYREN)'s Multifamily Building Enhancements program in California, Elevate Energy's Multifamily Program in Illinois, and Public Service Electric and Gas

(PSE&G)'s Multifamily Energy Efficiency Program in New Jersey. Each of these programs employs various aspects of design, but holds in common the use of an energy concierge that acts as a point of contact that connects multifamily building owners with efficiency services and assists with application and implementation processes.

Utilizing reported kWh savings for each of these programs, I estimate that annual unit-level savings associated with a concierge pilot will be 3,388.96 kWh. I then multiplied the expected savings per project by the 1,000-household target established in the scope of the alternative to obtain an estimated annual energy savings of 3,388,960 kWh. Because the programs used to generate this estimate are also capturing kWh savings from the actual installations of efficiency improvements, and the pilot I'm proposing does not include any of the efficiency improvement implementation in-house at Virginia Energy, this estimate likely overstates the relative effectiveness of this program, and I approach this estimate with some concerns, which I'll discuss in the implementation section. **This alternative ranks 2nd in terms of effectiveness.**

See Appendix IV for additional assumptions, choices, and calculations included in generating this figure.

<u>Cost</u>

Like the first alternative, an Energy Concierge Pilot Program would be limited to an information-sharing position at Virginia Energy. No new programs/staff would be required to implement additional energy efficiency projects at the agency. I project that the management of building owner/manager data and relationships, the knowledge of relevant sources of incentives and financing, and the administrative assistance provided by the Energy Concierge to assist owners/managers with applying for and receiving incentives and financing could be accomplished with the hiring of one additional employee. Using the same average salary for a Virginia Energy employee that was utilized earlier, along with my best estimate at the required level of effort for an employee to conduct the concierge activities, I developed an estimated staffing cost of $48,119.54. I also identified budget allocation information for an energy concierge pilot administered by the Sacramento Municipal Utilities District (SMUD) in California that was awarded $170,000 per year for administration. No capital for improvements would be needed by Virginia Energy. I decided to utilize the range of these two separate estimates to arrive at my final cost estimate for the agency.

I also estimated the costs associated with program participation for building owners/managers. I first estimated the number of buildings that would be covered by a 1,000-unit program by finding an average unit/building statistic from the US Census Bureau for new construction multifamily buildings in 2023. This amounted to an average of 28.125 units per building and therefore an estimate that 36 buildings would participate in the pilot. I then made my best attempt at an estimate of the required level of effort for a building owner/manager to carry out the activities associated with program participation, such as compiling application materials, coordinating with the energy concierge and other stakeholders, and communicating with residents and arrived at a value of 40 hours per project. I identified an average building manager salary in Virginia of $32.87. By taking the product of hourly wage, hours per project, and the number of expected projects, I calculated an opportunity cost equal to $70,992 for 36 building managers to work through the process of obtaining efficiency improvements in their buildings. Finally, I utilized a report on a multifamily efficiency improvement program in Orlando, FL, which calculated the average cost of improvements per multifamily unit as $4,359. Multiplying this value by the 1,000-unit scope of the pilot, I estimated the capital cost of $4,359,000. Combining the staffing and capital costs for building owners/managers and the staffing costs for Virginia energy, I arrived at a final estimate of the costs of alternative 2 equal to $4,478,119-$4,599,999. **This alternative ranks 2nd in terms of cost.**

See Appendix V for additional assumptions, choices, and calculations included in generating this figure.

Feasibility

As was previously noted, Virginia's legislators have demonstrated an interest in improving the uptake of efficiency programs for low-income individuals, so this policy is considered highly politically feasible. Unlike alternative 2, I don't anticipate this policy will invite any dissent from the state's utility companies. Existing stakeholders such as utilities, Virginia Housing, and the Virginia Department of Housing and Community Development would benefit from marketing and administration services provided by the state that supports uptake of their programs, so I don't predict pushback from stakeholders, and I conclude that this alternative has high political feasibility. While a high level of expertise, familiarity with programs and policies, and communication availability would be required of the employee(s) of Virginia Energy implementing this alternative, I don't foresee high levels of administrative burden. Furthermore, this policy would require strong collaboration between Virginia Energy with utilities and private entities to maximize program uptake, an incentive shared by the various involved stakeholders, facilitating high administrative feasibility. **Overall, this alternative ranks 1st in terms of feasibility.**

Alternative 3: Combine Comprehensive Retrofits and Solar Photovoltaic

Effectiveness

Under this alternative, Virginia's Clean Energy Advisory Board, which oversees implementing the state's $156 million Solar for All program, would require energy audits and subsequent efficiency upgrades to be made to low-income multifamily buildings before solar PV installations funded under the program. Several qualitative studies and solar installation websites describe additional energy savings attributable to combining energy efficiency with solar PV installations for multifamily buildings, but I didn't find any data that quantified these gains. I attempted to estimate the average kWh savings of this alternative by taking the sum of savings associated with solar installations in multifamily buildings and savings associated with energy efficiency improvements to multifamily buildings, and multiplying these savings by the 1,000-unit scope of the pilot. A US Department of Energy report on the impacts of solar installations at an affordable multifamily complex in California led me to estimate that solar installations will result in 1,552 kWh of savings per unit. The previously cited study of multifamily efficiency retrofits conducted in Orlando suggests that a set of improvements that included heat pumps, appliances, insulation, duct repairs, and lighting upgrades yielded average per-unit kWh savings of $2,094. I also identified savings reported for Rocky Mountain Power's Multifamily Demand Side Management in Utah in 2023 as 2,515 kWh per unit. By averaging these two sources of data, I estimated per-unit savings from efficiency retrofits to be 3,856 kWh per unit, and annual energy savings for alternative 3 to be 3,856,000 kWh. **This alternative ranks 3rd in terms of effectiveness.**

See Appendix VI for additional assumptions, choices, and calculations included in generating this figure.

Cost

This alternative includes a program design choice by Virginia's Clean Energy Advisory Board to require that multifamily buildings seeking to receive free/subsidized solar PV installations under the Solar-for-All program first pursue energy audits and receive necessary efficiency upgrades. Estimating costs for this program is particularly challenging because of the lack of program guidance that has been released by Virginia Energy regarding implementation. I did not identify any information about, for example, what percentage of project costs would be covered by Virginia Energy's Solar-For-All program. It is a requirement that projects result in at least 20% energy savings, but I was not able to identify guidance on the formulas and models that would guarantee that threshold was met, including the level of funding available for each installation. I assume no additional costs will be incurred by Virginia Energy should they opt for this policy decision, as it will merely entail a policy design choice that will be implemented by other parties. However, there will be some additional administrative burden to building owners pursuing efficiency improvements, in addition to solar installations. I do not include capital costs as a consideration for this calculation because of the lack of clarity at this time as to what the required investment will be for property owners and tenants, so my estimate is likely considerably lower than what the policy may end up costing, depending on Virginia Energy's policy design choices. Using an estimate of 20 additional hours of administrative work for building managers per project, as well as the earlier cited average building manager salary, and the number of buildings expected to participate in a 1,000-unit pilot, I estimated the costs of alternative 3 as $23,666. **This alternative ranks 1st in terms of cost.**

See Appendix VII for additional assumptions, choices, and calculations included in generating this figure.

<u>Feasibility</u>

President Trump's administration issued an executive order freezing Solar for All grants (along with other Inflation Reduction Act programs), so it is unclear when and how these funds will be unfrozen and whether Virginia Energy will be able to administer its Solar for All program (”Freeze on “Solar for All" State Grants Leave Virginia in the Dark”, 2025). This alternative therefore has low political feasibility. Combining energy efficiency improvements along with home solar installations is becoming increasingly popular, and the US Environmental Protection Agency made clear in its guidance to grant applicants that efficiency improvements may be incorporated into the applicants' proposed program designs and budget formulas (“Frequent

Questions about Solar for All", 2025). This implementation choice may require additional coordination for Virginia Energy to incorporate energy efficiency auditors and contractors into processes that otherwise would have been limited to solar energy installers. This will add some level of additional administrative burden compared to a standalone solar program design, but there may be overlaps between solar and efficiency contractors and implementors anyway, so I assess this policy as moderately administratively feasible. **This alternative ranks 3rd in terms of feasibility.**

Outcomes Matrix

Criteria	Alternative 1: OBF Pilot Program	Alternative 2: Energy Concierge Pilot Program	Alternative 3: Combined EE/Solar PV Program
Effectiveness (annual energy savings across the state)	6,964,890 kWh Rank = 1	3,388,960 kWh Rank = 3	3,856,000 kWh Rank = 2
Cost (Additional costs for Virginia Energy)	$8,195,313 Rank = 3	$4,478,119-$4,599,999 Rank = 2	$23,666 Rank = 1
Feasibility (Political and Administrative)	Political: Low, Administrative: High Rank = 2	Political: High, Administrative: High Rank = 1	Political: Low, Administrative: Moderate Rank = 3

Implementation Considerations

To ensure that the benefits of the proposed alternatives are experienced by low-income Virginians living in multifamily housing, energy savings must be retained by tenants, and not cancelled out by rent increases from building managers once efficiency improvements are made. To that end, I recommend that each of the alternatives target households living in subsidized affordable housing in the state. Each of the prominent affordable housing programs discussed earlier in the paper, and in more detail in Appendix VIII, includes program components that restrict landlords' abilities to increase rent. Under the HUD Section 8 Housing Choice Voucher and Section 8 Project-Based Assistance, local public housing authorities can make determinations related to requested rent increases, and the fact that improvements have been made does not necessarily justify a rent increase (“HUD Exchange”, n.d.). Likewise, HUD has set in place a 10% limit to rent increases in properties benefiting from Low Income Housing Tax Credits (National Low Income Housing Coalition, 2024). Virginia Legislators might also utilize other approaches to ensure the flow of savings to households, similar to Tenant Protection measures included in the national Weatherization Assistance Program (WAP) that safeguard WAP’s benefits to tenants. The national WAP statute that’s that benefits of WAP must accrue primarily to the low-income tenants residing in units, and that these individuals won’t be subjected to rent increases for a reasonable period unless those increases are demonstrably related to other improvements/circumstances than the efficiency improvements (National Housing Law Project, 2018). In Virginia, the WAP program requires that property owners agree not to increase rent for two years unless the increase is unrelated to the WAP improvements (“Virginia Weatherization Assistance Program”, 2018). I therefore recommend that tenant protections be provided for in the implementation of any of these policy proposals, either through provisions included in legislation or through program implementation guidance developed by Virginia Energy.

Alternative 1: Administer an On-Bill Financing Pilot Program

Sequence of Activities

1) The Virginia General Assembly passes legislation requiring one of the state’s investor-owned utilities (IOUs) to file plans for an OBF pilot program utilizing capital from Virginia Energy.
2) An OBF program filed by one of the state’s Investor-Owned Utilities (IOUs) receives approval from the state corporation commission.
3) Virginia Energy and one of the state’s IOUs publicize the availability of the OBF program and coordinate with existing energy efficiency contractors to set up mechanisms of financing disbursements and repayment through line items on individual households’ utility bills.

Key Dependencies and Risks to Successful Implementation

1) An IOU must be able to demonstrate cost-effectiveness to the state's corporation commission to receive approval for the program. This can be accomplished by including evidence from programs in other states achieving cost-effectiveness, and by including considerations of the target customer base, sources of capital from Virginia Energy, and considerations of health improvements and other secondary benefits that result from energy efficiency improvements in low-income households (Henderson, 2013).
2) Program participation may be hindered by the administrative burden perceived by potential participants or by the perception of additional costs from pursuing upgraded equipment. This can be overcome through thoughtful development of materials emphasizing the mechanisms of on-bill financing that eliminate credit requirements and accruing of debt, and tie repayment of loans to the meter rather than the individual living in the unit at the time of installation. Program implementers must communicate effectively that the savings from reductions in energy use will outweigh the on-bill surcharge, resulting in net savings.

Alternative 2: Administer an Energy Concierge Service Pilot Program

<u>Sequence of Activities</u>

1) The Virginia General Assembly passes legislation requiring Virginia Energy to implement an Energy Concierge pilot program.
2) Virginia Energy solidifies expertise around available sources of funding and financing from the state's utilities, the Virginia Housing Authority, the Virginia Department of Housing Development, and other potential sources.
3) Virginia Energy publicizes the availability of this service, and multifamily building owners and managers utilize the service as they pursue efficiency upgrades.

<u>Key Dependencies and Risks to Successful Implementation</u>

1) When adequate information is provided to multifamily building owners, the level of available funding may not be sufficient to overcome the issue of split incentives and motivate building owners to complete efficiency improvements. Additionally, the literature that informed the formulation of this alternative suggests a significant information asymmetry and the existence of incentives for building owners and renters to pursue efficiency improvements may not pan out in practice in Virginia. I had difficulty

establishing potential energy savings associated with this alternative based on a lack of stand-alone state-administered concierge programs. These concerns can be at least in part alleviated with impactful collaborations between Virginia Energy and local housing authorities and other stakeholders, as well as by establishing effective case studies that demonstrate cost-effectiveness to building owners. Virginia Energy may consider a qualitative assessment of building owners' opinions about pursuing efficiency improvements as an early component of program implementation.

2) Coordination amongst various stakeholders may lead to administrative challenges in facilitating, tracking, and quantifying program impacts. Stakeholders' incentives align with Virginia Energy's to maximize the uptake of efficiency programs in multifamily buildings occupied by low-income households. This can be overcome by developing centralized management practices at Virginia Energy as a component of implementation.

Alternative 3: Combine Comprehensive Retrofits and Solar Photovoltaic

<u>Sequence of Activities</u>

1) The Virginia Clean Energy Board receives authorization from the federal government or the Governor to resume planning for the Solar for All program in Virginia.
2) The Virginia Clean Energy Board creates requirements for energy audits and installation of improvements as prerequisites for multifamily buildings receiving subsidized solar installations, affecting up to 1,000 multifamily units.
3) During the implementation of Solar for All projects, service providers integrate energy efficiency contractors in the state to conduct audits, install efficiency improvements, and verify energy savings before proceeding with solar installations.

<u>Key Dependencies and Risks to Successful Implementation</u>

1) It may be multiple years before the Trump administration decides to or is forced to release funds authorized in the Inflation Reduction Act, including the money allocated for Virginia's Solar for All program.
2) Multifamily building owners may not perceive cost-effectiveness in the pursuit of solar installations and recognize the added benefits associated with efficiency improvements. The requirement of energy efficiency improvements may lead building owners to perceive additional costs that discourage program participation. Under the Solar-For-All

program, projects are required to meet the threshold of 20% energy savings; Virginia Energy should emphasize net benefits in the long-run, as well as other benefits associated with solar installations such as increasing net operating income, reducing tenants' utility costs, and environmental benefits (Samarripas and York, 2018).

3) Integration of energy audits, efficiency improvements, and savings verifications might create an administrative burden that impacts multifamily building owners' interest in program participation. Virginia Energy can overcome this through effective program design and "road mapping" of processes that make explicit the reasons for this program requirement. Virginia Energy can also develop marketing materials in coordination with stakeholders, demonstrating the benefits of combining efficiency and solar PV installations.

Recommendation

Based on my initial findings as outlined in this report, **I recommend that the Virginia General Assembly require Virginia Energy to develop and implement an Energy Concierge pilot program**. This alternative earned the highest average rank across each of my selected criteria. While it may be less effective at achieving energy savings for the target population than an On-Bill Financing pilot program, it is also less expensive and more feasible. Given some of the concerns outlined by this paper in quantifying potential kWh savings and costs associated with the alternatives, feasibility emerges as the critical criterion by which to assess the proposals. Feasibility is extremely important given the current political climate; the state legislature has already required the Virginia Department of Housing Development to conduct a study about increasing efficiency program uptake for low-income Virginians due in 2026. An energy concierge pilot will impose limited costs on the state government and will support coordination amongst energy efficiency stakeholders ahead of future outcomes from the VDHD's report. Implementation obstacles are also less technical and more easily overcome through effective coordination and marketing efforts on the part of Virginia Energy. Furthermore, a concierge pilot program focuses on overcoming information barriers and reducing administrative costs to maximize the effectiveness of existing resources. Overall, I suggest that an energy concierge pilot is the ideal policy alternative at this time to help reduce the energy burden experienced by low-income Virginians living in multifamily housing.

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Appendices

Appendix I: Literature Review of Proposed Alternatives

<u>On-Bill Financing Models</u>

Utilities and other program administrators increasingly employ on-bill financing mechanisms to overcome barriers to low-income households' investments in energy efficiency upgrades. Broadly speaking, on-bill repayment programs include utilities or third parties investing in installations of efficient equipment, which are paid back over time on the utility bill for the property, rather than being tied to the resident at the time (Henderson, 2013; Bianco and Sonvilla, 2021). There is a range of literature demonstrating the ability of on-bill financing and other financing solutions to overcome split incentives (Brown et al, 2019; Kim et al, 2012; Schröder et al, 2011; Zimring et al, 2014).

A qualitative review of utility on-bill programs completed in 2014 utilized program evaluation reports to identify lifetime savings of existing on-bill programs and found that the 30 programs examined in the report had delivered $1.8 billion of financing with default rates ranging from zero to three percent (Zimring et al, 2014), but did not include any quantitative analysis of program impact in terms of efficiency gains. The study also provides several key considerations for program designs, including disconnection/metering criteria, underwriting criteria, sources of capital, and eligible measures (Zimring et al, 2014).

A separate qualitative review of existing literature and program interviews utilizes a SWOT analysis to demonstrate that on-bill financing schemes can successfully address the issue of split incentives for energy efficiency adoption in multifamily properties (Bianco and Sevilla et al, 2021). This study focuses on applications in European residential markets but makes similar conclusions on the ability of on-bill financing programs to utilize financing institutions, credit considerations, and meter attachment mechanisms to successfully stimulate investment in tenant-occupied housing (Bianco and Sevilla et al, 2021).

Some states such as New York are beginning to offer on-bill financing services in coordination with utilities and green financing institutions to building owners (*Multifamily Financing Programs,* n.d., "On-Bill Recovery Loan", n.d.). Having recently launched its own Virginia Clean Energy Investment Bank, Virginia Energy may wish to explore this option. This would involve reviewing New York's available programs as well as existing utility on-bill programs such as those administered in California and Hawaii. While state commissions typically require utility-administered programs to undergo cost-benefit analyses demonstrating their savings, state-run programs are not, so data evaluating these programs would be extremely beneficial to Virginia Energy's assessment of this option.

<u>Offering a One-Stop Shop/Concierge Service</u>

A key barrier to the adoption of multifamily efficiency upgrades is a lack of knowledge about available capital/financing for building owners to make initial investments. As discussed previously, a variety of financing options already exist in Virginia for low-income multifamily buildings, such as those offered by the Virginia Department of Housing and Community Development (*Multifamily*, n.d.) and the Virginia Housing Finance Agency (*HCVP Resources for Landlords*, n.d.). Virginia Energy may wish to offer agency assistance that facilitates connections between multifamily building owners and the variety of funding and technical assistance available throughout the state.

Underlying the strategy of a one-stop shop or concierge service is the idea that an information gap exists among multifamily building owners as to the sources of available financing for energy improvements, which has been discussed in a wide range of literature (Miller, 2012; Olsthoorn et al, 2017; Schleich, 2004; Palmer et al, 2012). A qualitative study that interviewed multifamily program administrators around the country concluded that a key strategy to support building owners' investment in efficiency upgrades is compiling information and offering a "one-stop shop" for interested parties (Samarripas & York, 2019). The same study notes that effective resources consider the entirety of the "capital stack", which includes contributions from multiple stakeholders such as housing authorities, community action agencies, and economic development agencies (Samarripas & York, 2019).

In a separate mixed methods study that assessed program participation for thirty utility-administered multifamily efficiency programs and conducted interviews with thirteen program administrators, researchers concluded that one-stop shop offerings help to streamline the implementation process and address the specific needs of customers (Ross et al, 2016). They found that concierge services can be extremely effective in assisting customers with navigating a diverse set of stakeholders, including electric, gas, and water utilities, housing finance agencies (such as Virginia Housing), and community organizations (Ross et al, 2016). An example of such a program is offered by the Bay Area Regional Energy Network (BayREN), which offers free concierge services to local governments in its service territory to assist with accessing funding and navigating program applications (“Energy Concierge”, n.d.). Once again, the studies described above considered utility-administered multifamily efficiency programs, so while they are not directly generalizable to Virginia Energy, they begin to serve as effective research to justify consideration of this type of policy adoption. Additional quantitative controlled experiments are needed to determine the extent to which these resources help overcome information asymmetries and lead to the development and implementation of successful efficiency upgrades.

<u>Combine Comprehensive Retrofits and Solar Photovoltaic</u>

Affordable multifamily housing providers are increasingly finding that combined investments in both efficiency and solar photovoltaic (PV) development lead to more significant utility cost savings (Samarripas and York, 2018; Srivastava et al, 2020). In Virginia, Governor Youngkin established a Clean Energy Advisory Board to develop a program that disburses loans or rebates for the installation of solar energy infrastructure in low- and moderate-income households through the "Low-to-Moderate Income Solar Loan and Rebate Fund" (“Clean Energy Advisory Board”*,* n.d.). This board could opt to require affordable multifamily owners that install solar energy to also install efficiency upgrades. This program approach is already utilized by California’s Low-Income Weatherization Program for Multifamily Properties, which also provides technical assistance and financial incentives (“Multi-Family Energy Efficiency and Renewables”, 2024).

A qualitative report carried out by ACEEE conducted interviews with ten separate organizations, including program administrators, housing providers, and energy service companies to investigate approaches to integrating energy efficiency and solar resources. The researchers concluded that integrating energy efficiency with solar resources yields significant utility cost savings and environmental benefits and helps to stabilize housing costs for low-income families (Samarripas and York, 2018).

A separate qualitative ACEEE study that consisted of a literature review of existing studies and utility program filings and interviews with industry experts and administrators investigated how utility programs can integrate energy efficiency, solar power, and battery storage to benefit customers. The study concludes that integrated programs can result in benefits such as cost savings, emissions reductions, grid stability, and resiliency, and that program design components such as on-bill financing and performance-based incentives will help make participation more feasible for low-income households (Srivastava et al, 2020).

Lastly, a case study of Duke Carolina's service territory found that combining the adoption of residential roof-top solar PV with end-use energy efficiency measures increases energy savings compared to energy efficiency upgrades alone and significantly reduces operation costs and emissions (Alqahtani & Patiño-Echeverri, 2019). This study was limited to a specific service area that is more reliant on nuclear energy than most of Virginia, so a similarly designed study in Dominion Energy or Appalachian Power's Virginia service territories would benefit policymakers in the state. These types of studies help demonstrate the benefits of integrated solar and efficiency programs and discuss both utility- and state-administered applications. Additional quantitative evaluations that establish causality for energy burden reductions would benefit Virginia legislators and members of Virginia Energy as they consider implementing this policy approach in the state.

Appendix II: Effectiveness Calculation for On-Bill Financing Pilot

Under this alternative, the state will provide financing for installations of energy-efficient equipment in 1,000 multi-family units. To calculate the expected kWh savings from these upgrades, I include below a table summarizing the kWh savings experienced by OBF programs administered by four electric cooperatives in the Southeastern US.

Program	**Average Dollars Financed**	**Average Monthly Energy Savings**	**Average State Electricity Rate (2020)**	**kWh Savings (Monthly Energy Savings/State Electricity Rate)**
Ouachita Electric Cooperative – HELP PAYS® (AR)	$6,041	$71.50	$0.1051/kWh	680.30 kWh/month
MACED – How$mart®KY (KY)	$7,743	$51.98	$0.1067/kWh	487.16 kWh/month

Roanoke Electric Cooperative – Upgrade to $ave (NC)	$7,096	$74.33	$0.1156/kWh	642.99 kwh/month
Appalachian Electric Cooperative – U-$ave Advantage (TN)	$6,730	$63,08	$0.1234/kWh	511.18 kwh/month
Average monthly energy savings per upgrade = 580.41 kWh Average annual energy savings per upgrade = 6964.89 kWh				

Source: Southeast Energy Efficiency Alliance, 2020

*Annual energy savings = # of upgrades*annual energy savings per upgrade*

Annual energy savings = 1,000*6964.89 kWh = 6,964,890 kWh

Descriptions of Programs utilized for estimates:

- Ouachita Electric Cooperative – HELP PAYS® (AR): operated by an electric cooperative in Arkansas, this program prioritized multifamily homes and offered to provide capital for upgrades in every rental unit that was assessed. 100 percent of eligible units opted into the program.
- MACED – How$mart®KY (KY): offered by the Mountain Association for Community Economic Development in coordination with six electric cooperatives in Kentucky, this program focused on residential and small commercial customers.
- Roanoke Electric Cooperative – Upgrade to $ave (NC): offered by an electric cooperative in North Carolina.
- Appalachian Electric Cooperative – U-$ave Advantage (TN): offered by an electric cooperative in Tennessee, utilizes the Pay as You Save (PAYS) program design.

Other estimates of savings:

- "Basic energy efficiency investments such as insulation, air sealing, heat pumps and lighting upgrades have been shown to generate an average energy savings of 25%" (Southeast Energy Efficiency Alliance, 2020)

- Ouachita Electric Cooperative– HELP PAYS® program achieves average participant savings of 20% and the Seattle City Light On-bill Repayment Program achieves average participant savings of 25% (“Clean Energy Finance: On-bill Programs”, 2019)

Appendix III: Cost Calculations for On-Bill Financing

This alternative includes a pilot program administered by Virginia Energy in coordination with state utilities and existing energy efficiency contractors to facilitate installations of energy efficient equipment. The pilot will target 1,000 low-income multifamily units in the state. The cost of carrying out the program will primarily fall upon utilities marketing the program to multifamily customers and working with contractors to conduct efficiency audits and complete installations of efficient equipment. The state’s costs are therefore made up of staffing costs to coordinate stakeholders and ensure payments are made to contractors, and the capital associated with these loans.

Total Costs = Costs for Virginia Energy + Costs to Participating Households + Costs to Participating Building Owners/Managers

1) Costs for VA Energy:

Staffing costs = # of additional employees * annual salary * duration of pilot (years)

In order to estimate how long it would take a pilot OBF program to reach 1,000 customers, I utilized a report containing participation statistics for four OBF programs:

OBF Program from Case Study	Duration (years)	Lifetime Participants	Participants/year
City of Tallahassee Utilities: Energy Efficiency Loans	32	17,000	531.25
Eugene Water and Electric Board (EWEB) Energy Efficiency Loan Program	20	12,500	625
South Carolina’s CEPCI	5	125	125

Help My House Program			
Midwest Energy's How$mart Program	8	1411	176.38
Average Participants/Year = 364.41			

Source: EESI, 2015

Staffing costs = # of additional employees * annual salary * duration of pilot (years)

Assumption	Value	Source/Justification
# of additional state employees	1.00	While operating an OBF program in-house may require several full-time staff (EESI, 2017), this is a limited pilot that will be administered in coordination with state utilities.
Est. Annual Salary	$69,506	Average Virginia Energy employee salary in 2023 (GovSalaries, 2023)
Duration of Pilot	2.74 Years	Average participants/year of 4 case studies of OBF programs = 364.41 (EESI, 2015). Pursuing 1,000 participants/364.41 = 2.74 years
Inflation Rate	2.8%	Year-over-year inflation rate in February 2025, the most recent value available from the U.S. Bureau of Labor Statistics. (U.S. Bureau of Labor Statistics, 2025).

Staffing costs = # of additional employees * annual salary * duration of pilot (years)

Staffing Costs Calculation (with inflation)

Program Year	Year	Salary (with inflation)	% of Year	Salary * %Year

Year 1	2025	$69,506	1.00	$69,506
Year 2	2026	$71,452.17	1.00	$71,452.17
Year 3	2027	$73,452.83	0.74	$54,355.09
				Total Salary for 2.74-year pilot = $195,313

Capital Costs = average cost per project * number of projects

Assumption	Value	Source/Justification
Average cost per project	$8,000	EPA assessment of the average loan amounts included in a 2016 assessment of 45 on-bill programs nationwide ("Clean Energy Finance: On-bill Programs, 2019).
# of Projects	1,000	The scope of pilot program determined by author.

Capital Costs = average cost per project * number of projects

Capital Costs = $8,000 * 1,000 = $8,000,000

Total Costs for Virginia Energy = staffing costs + capital costs

Total costs for Virginia Energy = $195,313.26+ $8,000,000 = $8,195,313.26

2) Costs for Participating Homeowners

= Hours per project * Hourly Wage * Number of Projects

Hours per project	10	Estimate based on time at home for energy audit and installation, preparing application materials, discussing approval with building, etc.
Hourly Wage	$12.41	Virginia's minimum wage in 2025 (Department of Labor, 2025).
Number of Projects	1,000	Scope of pilot program

Total Cost for Participating Households = Hours per project * Hourly wage * Number of projects

Total Cost for Participating Households = 10 * $12.41 *1,000 = $124,1000

Total Cost for Participating Households = $124,100

3) Costs for Participating Building Owners/Managers

= Hours per project * Hourly Wage * Number of Projects

Hours per project	5	Estimate based on preparing application materials, providing approval for project.
Hourly Wage	$32.87	Average hourly wage for property managers in Virginia (GovSalaries.com, 2025).
Number of Projects	1,000	Scope of pilot program

Total Cost for Participating Households = Hours per project * Hourly wage * Number of projects

Total Cost for Participating Households = 5 * $32.87 *1,000 = $164,350

Total Cost for Participating Building Owners/Managers = $164,350

Total Costs = Costs for Virginia Energy + Costs to Participating Households + Costs to Participating Building Owners/Managers

Total Costs = $8,195,313.26 + $124,100 + $164,350

Total Costs for Alternative 1 = $8,483,763

Appendix IV: Effectiveness Calculations for Energy Concierge Services

The goal of the Energy Concierge Service pilot program is to overcome information asymmetries by providing a one-stop shop at Virginia Energy where building owners and property managers can receive personal consultations about availability of utility incentives, state and local rebates and tax credits, and various sources of financing. I will attempt to project how an Energy

Concierge pilot for multifamily building owners primarily serving low-income households impacts energy efficiency improvements.

The following table contains data about three multifamily energy efficiency programs which utilize a one-stop approach similar to the energy concierge program proposed under this alternative: the Bay Area Regional Energy Network (BayREN) Bay Area Multifamily Building Enhancements program; the Elevate Energy Multifamily Program, and the Public Service Electric and Gas (PSE&G) Multifamily Energy Efficiency Program.

Program	Program Year(s)	Annual Participation	First year incremental energy savings (kWh)	Average per unit energy savings (kWh)
Bay Area Regional Energy Network Bay Area Multifamily Building Enhancements (CA)	2015	7,512	10,996,100	691.75
Elevate Energy Multifamily Program (IL)	2008-2016	56,933 (cumulative)	186,750,068	3280.17
Public Service Electric and Gas (PSE&G) Multifamily Energy Efficiency Program (NJ)	2011-2015	11,000 (cumulative)	68,144,591	6,194.96
				Average annual energy savings per unit = 3,388.96 kWh

Source: Ross et al, 2017

*Annual energy savings = # of upgrades*annual energy savings per upgrade*

Annual energy savings for Alternative 2= 1,000*3,388.96 = 3,388,960.94 kWh

Appendix V: Cost Calculations for Energy Concierge Services

The goal of the Energy Concierge Service pilot program is to overcome information asymmetries by providing a one-stop shop at Virginia Energy where building owners and property managers can receive personal consultations about availability of utility incentives, state and local rebates and tax credits, and various sources of financing. Like the OBF program, this pilot will incur staffing costs to Virginia Energy to serve the concierge role, as well as opportunity costs to building managers to work through applications, communicate with various program administrators, and be on-hand during energy audits and installations of energy efficiency improvements. Building owners/managers will also incur costs of investing in energy efficiency improvements.

1) How many buildings would be included in a 1,000-unit pilot program?

- In 2023, 450,000 multifamily units completed construction in 16,000 multifamily buildings (U.S. Census Bureau, 2023)
  - Average # of units per building = 28.125
- 1,000/28.125 = 35.55 ~ 36 buildings

2) *Costs for Virginia Energy*

Total Costs = Staffing Costs

Staffing Costs:

Staffing costs = # of additional employees * annual salary * duration of pilot (years)

Assumption	Value	Source/Justification
# of multifamily buildings participating in pilot	36 buildings	Based on above calculation of average # of units per multifamily building from the US Census Bureau.

# of hours of labor required per project	40	Author's assumption based on the following activities: communications with stakeholders, development of program materials, outreach to building managers and marketing of program, assistance with program applications and other administrative processes associated with receiving rebates efficiently, reporting of outcomes of pilot program
Est. Annual Salary	$69,506	Average Virginia Energy employee salary in 2023 (GovSalaries, 2023)
Hours of labor	1,440 or 0.69 years	# of hours required per project * # of buildings served

Staffing costs = 0.69 * 69,506

Staffing costs = 0.69 * $69,506 = $48,119.54

- Sacramento Municipal Utilities District (SMUD) was awarded an annual budget of $170,000 to implement a residential Concierge Service program over two years (Valley Clean Energy Alliance, 2024). I will use the range of my estimate of staffing requirements and SMUD's annual budget as a range of projected costs for this alternative.

Total Costs for Virginia Energy= $48,120-$170,000

3) Costs for Participating Building Owners/Managers

= Hours per project * Hourly Wage * Number of Projects

Hours per project	60	Estimate based on preparing application materials, communicating with Virginia Energy and other stakeholders, communicating with residents, providing approval for project.

Hourly Wage	$32.87	Average hourly wage for property managers in Virginia (GovSalaries.com, 2025).
Number of Projects	36	Scope of pilot program when converted from units to number of buildings

Staffing Costs for Participating Building Owners/Managers = Hours per project * Hourly wage * Number of projects

Staffing Costs for Participating Buildings = 60 * $32.87 * 36 = $70,992

Capital Costs for Participating Building Owners/Managers = Average cost per unit * number of units served

- A study conducted in Orlando about the impacts of energy efficiency improvements to multifamily properties indicated that the average cost per unit was $4,359. These multifamily buildings were served by the Orlando Utilities Commission, and the program design was coordinated with researchers from the University of Florida. These retrofits included upgraded heat pumps, appliances, insulation, duct repair, and lighting. (Taylor et al, 2015).

Capital costs = average cost per unit * number of units served

Capital Costs = $4,359 * 1,000 = $4,359,000

Total Costs for Building Owners/Managers = staffing costs + capital costs

Total costs for Building Owners/Managers = $70,999+ $4,359,000= $ 4,429,999

Total Costs = Costs for Virginia Energy + Costs for Participating Building Owners/Managers

Total Costs = $(48,120-$170,000) + $4,429,999

Total Costs for Alternative 2 = $4,478,119-$4,599,999

Appendix VI: Effectiveness Calculations for Combined Comprehensive Retrofits and Solar PV

Under this alternative, 1,000 multifamily units that are receiving Solar-For-All installations will also be required to receive energy efficiency retrofits. I will attempt to estimate the approximate kWh savings associated with this alternative, by estimating average kWh usage in multifamily units prior to improvements, kWh savings associated with solar installations, and kWh savings associated with energy efficiency upgrades.

1) Average household energy use

- Before the retrofits, both the control and treatment units used 9,134 kWh, with an average utility bill of $1,235 a year. (Taylor et al, 2015).
- Based on a study of multifamily energy efficiency retrofit programs done in Orlando, FL, published in 2015.

2) Savings associated with solar installations in affordable multifamily housing

- Average annual savings per project from EAH Housing Elena Gardens affordable multifamily housing project in California (2021) = $464 per residential unit ("EAH Housing: Expanding Solar Benefits for Affordable Multifamily Housing, n.d.)
    - 2021 PG&E Total Electricity Cost =$0.29884 (Ibid).
    - **1,552 kWh annual savings per residential unit**

3) Savings associated with energy efficiency retrofits in affordable multifamily housing

- A study conducted in Orlando about the impacts of energy efficiency improvements to multifamily properties indicated that the average annual energy savings per unit was $2,094 kWh. These multifamily buildings were served by the Orlando Utilities Commission, and the program design was coordinated with researchers from the University of Florida. These retrofits included upgraded heat pumps, appliances, insulation, duct repair, and lighting. (Taylor et al, 2015).
- Average per unit kWh savings for Rocky Mountain Power's Multifamily Demand Side Management Program in Utah in 2023 was 2,515 kWh ("How Programs Can Navigate Aggressive Change to Achieve Deep Energy Savings in Multifamily", 2024).

Average of these two estimates = (2,094 + 2,515)/2 = **2,304 kWh annual savings per residential unit**

Total Savings = annual savings from solar installation + total savings from efficiency retrofits

Total Savings = 1,552 kWh + 2,304 kWh = 3,856 kWh per unit

*Annual energy savings = # of participating units*annual energy savings per upgrade*

Annual Energy Savings for Alternative 3 = 1,000*3,856 kWh = 3,856,000 kWh

Appendix VII: Cost Calculations for Combined Comprehensive Retrofits and Solar PV

Under this alternative, Virginia Energy would require a certain efficiency standard be met for low-income households to qualify for the Virginia Solar-For-All program. Virginia Energy received a $156 million grant through the US Environmental Protection Agency to coordinate this program, of which 25% may be used for program implementation ($39 million). The EPA's guidance on program implementation states that, "Financial assistance for enabling upgrades may comprise up to 20% of the total financial assistance deployed during the lifetime of the program" and "all enabling upgrades should be energy and building infrastructure related and deployed in conjunction with financial assistance for an eligible solar PV system" ("Frequent Questions about Solar for All", 2025).

Because there is a capped budget on this program, and assuming Virginia Energy will spend the full $156 million budget regardless of program design, I assume **no additional costs** to Virginia Energy associated with this policy recommendation. Additionally, installations may receive funding for up to 100% of project costs; Virginia Energy has not yet advised how it plans to calculate costs covered. However, I include costs for building owners to pursue energy efficiency upgrades and solar installations.

Costs for Participating Building Owners/Managers = Hours per project * Hourly Wage * Number of Projects

Additional hours per project (difference between hours required for just solar installations and hours required for solar installations and efficiency improvements)	20	Estimate based on additional application materials, communicating with stakeholders, including additional contractors, communicating with residents, providing approval for project.
Hourly Wage	$32.87	Average hourly wage for property managers in Virginia (GovSalaries.com, 2025).
Number of Projects	36	Scope of pilot program when converted from units to number of buildings.

Staffing Costs for Participating Buildings = 20 * 32.87 * 36 =

Staffing Costs for Participating Buildings = 60 * $32.87 * 36 = $23,666

Total Costs for Alternative 2 = $23,666

Appendix VIII: Details about Affordable Housing Programs in Virginia

- Under the **HUD Section 8 Program**, local public housing agencies (PHAs) receive funding from HUD and in turn administer housing vouchers to income-qualified families. The PHA pays a subsidy directly to the property's landlord and the family that received the voucher is responsible for paying the difference between the actual rent charged by the landlord and the subsidy paid by the PHA (“Housing Choice Vouchers Fact Sheet, n.d.) Though eligibility requirements are determined by local PHAs, in general, a family’s income may not exceed 50 percent of the area median income (AMI). In Virginia, Housing Choice Vouchers are administered by Virginia Housing, a not-for-profit organization created by the state legislature to help Virginians attain quality, affordable housing (“Virginia Housing”, n.d.) in coordination with 31 PHAs, and as of September

2024, about 49,000 vouchers were being administered in the state ("Housing Choice Voucher Data Dashboard", 2024).

- Under the **HUD Public Housing Program**, HUD administers funding and technical and professional assistance to local housing agencies that manage public housing for affordable rent prices for low-income households ("HUD's Public Housing Program", n.d.). HUD sets lower income limits at 80 percent and very low-income limits at 50 percent of AMI. There are currently about 26,000 Virginians living in Public Housing ("Public Housing Data Dashboard", 2024).
- **HUD Section 8 Project-Based Rental Assistance** is a subcomponent of the Housing Choice Voucher program in which the voucher is tied to specific units or complexes. Unlike Housing Choice Vouchers, tenants must live in designated housing to receive the subsidy; if they move out, the subsidy remains with the unit, and the next tenant will benefit from the project-based voucher (PBV) (Richey, 2023). Like the Housing Choice Voucher program, participants in Virginia's income may not exceed 50 percent of AMI. As of September 2024, 6,017 PBV units were being leased, and 380 qualified units were unleased ("Housing Choice Voucher Data Dashboard", 2024).
- The federal **Low-Income Housing Tax Credit (LIHTC or Housing Tax Credit)** is sponsored by the U.S. Treasury Department and administered in Virginia by Virginia Housing. Under the program, developers of either new construction or rehabilitation projects receive tax credits for setting aside portions of developments for low-income tenants. Eligible properties include large apartment buildings as well as smaller 2–4-unit buildings. There are three ways for rental properties to meet LIHTC income eligibility requirements:
    - At least 20 percent of the project's units are occupied by tenants with an income of 50 percent or less of AMI adjusted for family size.
    - At least 40 percent of the units are occupied by tenants with an income of 60 percent or less of AMI.
    - At least 40 percent of the units are occupied by tenants with income averaging no more than 60 percent of AMI, and no units are occupied by tenants with income greater than 80 percent of AMI

- Additionally, rents may not exceed 30 percent of either 50 or 60 percent of AMI, depending on the proportion of eligible units in the project ("The Tax Policy Briefing Book", n.d.)

Virginia Housing administers both the 9 percent LIHTC, which is competitively allocated, as well as the 4 percent LIHTC, which projects qualify for automatically if they meet the income thresholds outlined above ("Low-Income Housing Tax Credit Program", 2021). From 2017-2021, Virginia's LIHTC program administered between \$32.9-\$67.3 million in credits and supported the creation or rehabilitation of 5,500 units per year ("Program Fact Sheet: Low-Income Housing Tax Credit", 2021).