Commonwealth Clean Energy Financing Authority
Preliminary Market Assessment Report
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Maximizing the Economic Opportunity of Clean Energy through Green Banks

Virginia is already one of the top ten states nationwide for clean energy employment[i] and its clean energy economy represents several billion dollars of economic activity annually[ii]. There is much more opportunity to be realized as clean energy markets continue to expand. One of the ways states and localities across the U.S. are working to maximize the economic benefits that accrue to their own jurisdictions is by establishing green banks. Green banks are specialized financing institutions that efficiently use limited public resources to mobilize private investment in clean energy, clean transport, and climate resilience projects. Specifically, states and localities have established such green banks in pursuit of:

- Opening up new market opportunities for existing clean energy businesses in their jurisdiction;
- Attracting additional clean energy businesses to their jurisdiction;
- Securing the new jobs and tax revenues that come from expanding existing businesses and attracting new ones;
- Increasing market competition, distributed ownership, and consumer choice in the energy and transportation sectors;
- Reducing rather than increasing residents' and businesses' energy bills during the shift to a more efficient and cleaner electric system;
- Providing an opportunity for local governments to attract investment to their communities and meet greenhouse gas reduction goals;
- Supporting communities in their efforts to adapt to more frequent and severe weather events, such as increased flooding and extreme heat; and
- Mitigating supply-side challenges to clean energy generation, such as securing critical minerals, by ensuring that energy efficiency is a core part of the energy transition.

Virginia neighbors Maryland; Montgomery County, MD; the District of Columbia; and North Carolina have established green banks in furtherance of these goals. Green banks across the country have been created by and are thriving under Republican as well as Democratic leadership.[iii]

Existing green banks vary in legal structure and market approach to suit their local institutional and market landscape, but they operate under a common set of principles:

- Offering financing, rather than grants;
- Leveraging public capital to increase private investment in underserved market segments;
- Recycling funds to redeploy dollars and maximize investment; and
- Coordinating with and complementing other programs, such as those providing incentives or technical assistance.

Green banks work on both the supply and demand side of the clean energy, clean transport, and climate resilience financing markets. They work to spur supply of and demand for financing as well as to connect capital supply to customer demand as they expand.[iv]

Green banks use a wide variety of innovative financing and market development tools, such as co-investment with private financier partners to close a new type of transaction, credit enhancements like loan loss reserves that de-risk investments for private investors, aggregation and warehousing to facilitate the financing of smaller projects, and standardization to reduce uncertainty that drives up costs in the lending process.[v]

Operating under these principles and using these tools, green banks in the U.S. have enabled $7.0 billion in clean energy investment since 2011. As of 2020, every dollar invested by green banks led to an average of $3.70 of overall investment in the American clean energy economy.[vi]

Background and Goals of the Preliminary Market Assessment

In early 2021, the passage of HB1919 amended the Code of Virginia by adding section 15.2-958.3:1 authorizing localities to establish local green banks.[vii] A local-level market assessment in any Virginia locality interested in a local green bank will inform the feasibility of a successful entity based on its available resources and addressable market. However, there are two general challenges to establishing local green banks, both of which are related to scale.[viii]

First, there is a minimum cost of operating a green bank, whether at the locality or state level, and that cost is paid by generating operating revenue in the form of interest payments and fees. The more loan volume generated, the more revenue. Thus, the ability to be a self-sustaining operation is directly linked to loan volume, and small localities may not have enough potential loan volume to generate sufficient operating revenue.

Second, accelerating private investment in clean energy and clean transport projects requires scale. A reason many projects are left unfinanced is because they are too small to attract capital. A green bank manages programs that operate on a large enough scale to bring in private capital to an aggregated portfolio of small projects. Except in major population centers, local-level entities are unlikely to be able to achieve this level of portfolio scale.

The implication is that if establishing green banks is left to localities alone, there is a high risk that a few well-resourced localities will take advantage of the opportunity while the vast majority will not. This risks seeing greater accrual of benefits from clean energy projects in larger, well-resourced, largely urban localities and exacerbating existing geographic inequities across the Commonwealth.

In the interest of avoiding this potential for geographic inequity, the Virginia Department of Energy (Virginia Energy) conducted a preliminary market assessment to explore the potential role of a statewide entity in Virginia modeled after existing statewide green banks. To avoid

confusion with regulated, depository banks, Virginia Energy is referring to a potential statewide green bank as the Commonwealth Clean Energy Financing Authority (CEFA).

The preliminary market assessment assessed the market opportunity for a Commonwealth Clean Energy Financing Authority by:

1. Identifying financing gaps it could help to fill; and
2. Exploring how it could complement the existing policy and program landscape.

In conducting the preliminary market assessment, Virginia Energy solicited input on these questions via individual and small group virtual interviews with key stakeholders as well as via a widely disseminated written survey. Virginia Energy interviewed seventy-eight people from fifty-eight organizations, and sixty-five individuals responded to the written survey. Virginia Energy is grateful to everyone who generously provided their time and expertise during this process.

Overarching Challenges to Market Growth

There are specific challenges to accelerating the deployment of certain technologies and to certain consumer segments that are detailed in the sections below on Priority Market Segments: Gaps and Opportunities. But this preliminary market assessment also identified several overarching challenges to accelerating the equitable deployment of clean energy, clean transport, and climate resilience projects in Virginia. They include:

- High up-front cost and long payback periods;
- Lack of attractive financing options to drive demand;
- Particular lack of financing for LMI residents and small businesses;
- Low consumer awareness of and trust in contractors and financing options;
- Legal and practical restrictions for certain residents and businesses; and
- Contractor confusion about various programs.

High up-front cost and long payback periods

While some form of subsidy may exist to cover partial costs of clean energy, clean transport, and climate resilience projects, they are usually insufficient to cover the full cost. The often long payback periods of those projects disadvantage them against residents' and businesses' competing demands for capital. Additionally, many incentives that exist are not designed to be inclusive. For example, individuals and organizations without tax liability cannot take direct advantage of the federal Investment Tax Credit for solar system purchases as it is currently designed.

Lack of attractive financing options to drive demand

Financing options that enable consumers to start saving money at or shortly after project completion, in conjunction with widespread marketing of those options, can drive demand for projects. But most lenders, both commercial and community-based, are still unfamiliar with clean energy, clean transport, and climate resilience projects and lack financing options specific to them. Most lenders also lack confidence in such projects' ability to deliver cost savings.

Therefore, when traditional loans are used to finance projects, they usually fail to properly account for future savings from the project in the underwriting process, which if adopted would unlock much more capital for projects that reduce future costs.ix

Particular lack of financing for LMI residents and small businesses

Generally speaking, lenders not specifically oriented toward low-to-moderate income (LMI) residents and small businesses are less motivated to lend to those market segments than to their more affluent or larger peers. Low or lack of credit score is one reason. Another is that financing small projects is less attractive than large projects because transaction costs are largely the same regardless of size. Plus, lack of standardization of small projects makes it difficult to aggregate and sell them to an investor. Community Development Financial Institutions (CDFIs), mission-driven financial institutions with expertise in serving customers underserved by mainstream lenders, would be well suited to step in. But due to CDFIs' own limited capital sources and the relative newness of clean energy, clean transport, and climate resilience projects, CDFIs may struggle to finance such projects without technical and financial assistance.

Low consumer awareness of and trust in contractors and financing options

Even when financing options are available, consumers exploring clean energy, clean transport, and climate resilience opportunities for the first time may not be sure who to trust. They may be hesitant to take on debt, especially given doubts that projected savings will materialize. These challenges are especially present for underserved populations that tend to have many competing priorities for available funds and justified skepticism of new "opportunities".

Legal and practical restrictions for certain residents and businesses

Many residents and businesses are, without a creative solution, simply ineligible to engage in clean energy, clean transport, and climate resilience projects. This may be because they rent their home or place of businesses and thus lack decision making authority for property improvements, lack a suitable roof or other space for installing solar, or face some other legal or practical restriction.

Contractor confusion about various programs

Contractors, and especially contractors not specializing in clean energy, clean transport, or climate resilience projects, often find it difficult to identify utility and government programs for which a particular customer or project is eligible. This leads to missed opportunities to quote lower project costs and facilitate uptake of incentives.

Overarching Opportunities for the Clean Energy Financing Authority

The existence of these overarching challenges indicates there is opportunity for a specialized clean energy financing entity to help address them and unlock additional private investment and market growth in Virginia. Among the many activities stakeholders suggested such an entity could undertake are:

- Conduct marketing and outreach

- Provide or facilitate the provision of easy, low-cost, and standardized financing
- Promote alternative underwriting to expand access to financing
- Provide impartial guidance to consumers, including vetting contractors and lenders
- Serve as a resource for quality contractors and lenders
- Gather and disseminate information to the market and policymakers

Conduct marketing and outreach

There is a critical need for more overall consumer awareness of clean energy, clean transport, and climate resilience technologies and options for financing them. As an impartial and credible government-affiliated entity, the CEFA could play a key role in this awareness campaign, alongside the State Corporation Commission's (SCC's) Virginia Energy Sense online consumer education platform.

Provide or facilitate the provision of easy, low-cost, and standardized financing

The provision or facilitation of financing would be a key CEFA activity. It could finance projects directly, support projects via intermediaries (including via equity investments in CDFIs[x]), or pursue a combination of the two. The CEFA could establish and administer its own bespoke programs or work through organizations that have developed turnkey programs administered in various jurisdictions. However delivered, stakeholders suggested that financing would be most impactful if it:

- Makes projects cash flow positive at or shortly after completion, which requires a low interest rate and long loan terms;
- Has broad eligibility but differentiated, need-based terms (e.g. even lower interest rates or more generous underwriting for affordable housing than market-rate properties);
- Coordinates seamlessly with and leverages other programs;
- Requires minimal, easy-to-understand paperwork;
- Accounts for future savings from projects in the underwriting process;
- Whenever possible, does not require customers to take on debt (e.g., off-balance sheet or tariffed on-bill financing);
- Is offered across as large of a geographic area as possible (including in neighboring states in cooperation with their green banks), as a larger market opportunity spurs strong private sector participation;
- Is perceived as stable, since programs that offer contractors and lenders a short-term market opportunity motivate less resource investment; and
- Standardizes projects to the greatest extent possible, as this will allow for a connection between small projects and the enormous volumes of capital (especially "sustainable" or "ESG" investments) available in public debt markets.

Promote alternative underwriting to expand access to financing

In aiming to expand access to financing options to households and businesses that may have poor or no credit history, the CEFA could use or promote alternative underwriting practices. This can include using utility bill payment history and references to determine a borrower's repayment risk rather than (solely) credit and income information. Existing green banks have successfully worked with partners to expand underwriting guidelines and thus access to financing. Still, it is important to note that there are customer segments for which even the most affordable and innovative financing is not sufficient. Establishing the CEFA would not negate the need for subsidies to support no-cost clean energy, clean transport, and climate resilience, especially for households, businesses, and organizations that are most vulnerable to the potential consequences of financing arrangements. The CEFA would also need to establish strong consumer protection protocols based on national best practices.

Provide impartial guidance to consumers, including vetting contractors and lenders

Given the skepticism and confusion many residents and businesses feel about working with new companies and participating in new programs, the CEFA could serve as an impartial advisor. It could help customers navigate various program and project options as well as help customers avoid bad actors by only partnering with contractors and lenders that successfully pass through a vetting process.

Serve as a resource for quality contractors and lenders

The CEFA could also serve as an impartial advisor to contractors and lenders interested in (further) expanding their businesses into the clean energy, clean transport, and climate resilience markets. The CEFA could, for example, work with them to understand which programs are available to which customers and how to market them alongside other offerings.

Gather and disseminate information to the market and policymakers

As a financing entity motivated primarily by public interest and not profitability, the CEFA could play a key role in building the public's, industry's, and policymakers' awareness about the state of financing for clean energy, clean transport, and climate resilience projects, including by conducting or commissioning research[xi], publishing case studies of its own investments[xii], and convening stakeholders around identified challenges. Providing up-to-date information to legislators about rapidly evolving markets can help inform effective policy development. The CEFA can also ensure that clean energy-focused contractors and financiers are aware of the broader universe of policies that can facilitate projects, such as qualified opportunity zone tax benefits.[xiii]

While there are many ways the CEFA could help catalyze private investment in clean energy, clean transport, and climate resilience markets, other foundational elements of thriving markets

are necessary to fully realize these markets' growth potential. These include availability of data needed to inform decision making, growth and diversity of the clean energy workforce, and efficient planning and permitting processes for projects.

Priority Market Segments: Gaps and Opportunities

In considering the establishment of any new clean energy, clean transport, or climate resilience financing program, whether under the CEFA or some other entity, it is important that such a program complement rather than duplicate or compete with existing funding and financing options. A non-comprehensive list of key public and private funding and financing sources available in Virginia is in the Appendix. This preliminary market assessment indicates that while numerous funding and financing sources exist in Virginia, there are still financing gaps holding back market growth that additional, efficiently deployed public resources could fill. The sections below begin to explore how the CEFA could complement these existing options in the priority market segments of existing buildings, transportation, industry, and specifically in rural parts of the Commonwealth.

There are two caveats to this section. First, it contains many opportunities, and the CEFA would need to prioritize amongst them, rolling out programs across market segments over several years. That prioritization would be driven by the CEFA's mission and performance metrics. A focus on one or more of the possible performance metrics, such as maximizing public to private capital leverage ratio, maximizing job creation per public dollar deployed, and maximizing overall benefits to economically disadvantaged communities, would lead to differing sets of CEFA activities. The CEFA's mission, performance metrics, performance evaluation processes, and other protocols would be established by its governing statute and the CEFA governing body in consultation with localities, community based organizations, advocacy groups, and businesses, among others.

It is also important to note that this existing landscape of funding and financing options is constantly evolving, so gaps in that landscape will evolve over time as well. For that reason, it is important that any program or entity that aims to fill financing gaps has the flexibility to itself evolve in response to market changes.

Existing Buildings: Common Themes

Residential and commercial buildings consume half of all end-use energy consumed in Virginia, and together they are responsible for 35 percent of Virginia's emissions. Unlike costs outside of property owners' control, such as property taxes, energy costs represent a significant *controllable* cost. Property developers and owners are increasingly investing in energy efficient, energy producing, and climate resilient buildings ("high performance buildings") to not only lower utility bills, but also to improve indoor health and comfort, reduce vacancy rates (in rental properties), and increase building durability and market value.

Stakeholders indicated that for new construction of buildings, motivated developers tend to be able to secure financing for any additional costs of high-performance measures from their normal financial provider. New construction-oriented programs like Arlington's Green Building Incentive Policy, which offers developers bonus density in exchange for high-performance new construction, have successfully motivated developers of new buildings. Stronger building codes also continue to set the bar higher for new buildings. These are cost-efficient strategies, as incorporating high-efficiency, climate resilience, and electric vehicle charging (or readiness for it) tends to be much cheaper to incorporate at construction than as a retrofit. Still, there are cost and energy savings opportunities in Virginia's large existing building stock that are sitting untapped. As such, within the buildings sector, the CEFA should focus on improving energy performance and climate resilience of the existing building stock.

The existing buildings sector has numerous sub-sectors with their individual challenges and opportunities, but the following issues arose as those that the CEFA could help address in the existing buildings sector broadly. The sections that follow these overarching challenges highlight specific needs within the single family housing, multifamily housing, and non-multifamily commercial building market segments.

Misaligned financial incentives in rental properties

Paying for the upfront cost of clean energy, clean transport, and climate resilience measures is a challenge in any building, but it is especially challenging in rental properties where the owner covers those costs but tenants with individual utility accounts reap the benefits of lower utility bills. This tenant-owner split incentive is a well-known challenge in rental properties, including rental housing and commercial spaces rented by small businesses and nonprofits. Some tenants may be willing to pay for upgrades, but only if they are planning to rent in the property for long enough to justify the investment.

A property owner not responsible for tenants' utility bills may believe that there is no way to recoup an investment in energy improvements, so the project will not be done or will only encompass what can be installed at no cost. The CEFA could help property owners understand the less obvious opportunities for recouping costs and incorporate them into project design and underwriting. For example, even in an individually metered building with multiple tenants, there are utility bills that the owner pays for, like common areas. Like other types of improvements, energy improvements can also reduce operations and maintenance (O&M) costs and increase tenant satisfaction, which reduces vacancy. Especially when climate resilience benefits are valued (such as greater ability to withstand flooding), improvements can even reduce insurance premiums. Taken together, a project that taps into these various payback streams could be financially viable even in a building with tenant-paid utilities for individual units.

Missed opportunities for comprehensive energy upgrades

Declining energy and cost savings potential in buildings has begun to challenge utilities' ability to develop clean energy and clean transport programs that pass the SCC qualifying cost effectiveness tests. This declining potential is, at least in part, the result of having incentivized the installation of measures with short payback periods, such as lighting upgrades, rather than bundling them with additional energy-saving measures with longer payback periods. Deeper retrofits through bundling would achieve greater savings. Plus, customer-contractor interactions do not have solely monetary costs: agreeing to contracts and scheduling takes time and effort that both sides prefer to minimize. For these reasons, programs should aim to combine short- and long-payback measures into comprehensive, cost-effective projects.

There are practical reasons why many projects are not comprehensive. One is that many contractors offer a limited set of efficiency measures (e.g., insulation or HVAC equipment/services) that limit how they evaluate a building and what they will include in a recommended retrofit. Customers lack access to free, tech-neutral energy audits that evaluate a whole building and deliver a comprehensive list of recommendations prioritized for a particular building. Availability of such audits would catalyze a comprehensive retrofit market.

A promising model that enables comprehensive building retrofits given the existing set of contractors involves a sponsoring entity (e.g., a utility or green bank) hiring two program administrators, one financial and one technical. The program administrators develop a contractor network as well as partner lenders, unless the utility or green bank is serving as lender. The technical program administrator acquires customers, conducts energy audits, identifies the sets of qualified contractors needed, and manages those contractors for each comprehensive project. When a job is done, the financial program administrator manages paying each contractor separately. Critically, the customer agrees to one project and one financing solution.

If this approach were adopted by Virginia utilities, the CEFA could serve as the lender or could provide a credit enhancement to participating lenders to enable lower-cost, longer-term financing options. The CEFA could sponsor this type of program, in which case its program administrators would need to work closely with utilities to ensure customers are accessing all available incentives from their programs.

Legal and supply chain hurdles to beneficial electrification

Beneficial electrification of buildings involves a combination of: (1) reducing energy load by improving the building envelope while safeguarding indoor environmental quality, (2) installing highly efficient, all-electric equipment and appliances, and (3) using demand controls, on-site renewable energy, and energy storage to optimize energy usage.[xiv] Beneficial electrification promotes energy efficiency, as electric equipment such as electric heat pumps tend to be more fuel efficient than their non-electric alternatives. Maximizing energy efficiency, electrification,

and use of on-site renewables coupled with energy storage enhances climate resilience. Emissions of all-electric equipment will continue to decrease into the future as the grid transitions to zero-emission electricity.

One hurdle to widespread beneficial electrification of existing buildings is the low cost of natural gas in Virginia, weakening the financial case for switching load to higher-cost electric power. A second is that § 56-576 of the Code of Virginia defines "energy efficiency programs" as programs that reduce *electric* use, not *energy* use or emissions. This disqualifies electrification efforts from energy efficiency programs even when switching from propane to electric heating, for example, could reduce a customer's total energy use as well as their monthly bill. Third, many contractors are either not trained on electrification equipment, notably heat pumps and heat pump water heaters, or are trained but not promoting them. Lastly, the shelves contractors source products from are probably not stocked with that type of equipment.

There is little the CEFA can do to address the price of natural gas or legal constraints on beneficial electrification in Virginia. It could, however, help address contractor training and supply chain barriers, especially as related to heat pumps and heat pump water heaters. One strategy the CEFA could adopt is exemplified by the heat pump program run by Efficiency Vermont, the state's energy efficiency utility.[xv] Efficiency Vermont launched their full-scale residential and commercial heat pump program in 2014, and now Vermont is the number one per capita adopter of heat pumps in the U.S. Efficiency Vermont designs consumer incentives and financing options in collaboration with heat pump manufacturers, which leads those manufacturers to stock distributors' shelves with heat pumps and leads distributors to hold contractor training on those products. This program leverages the existing supply chain to supply contractors with and train them on new products rather than trying to do so as a separate "sustainability" effort. The success of this approach lies in not relying on consumer demand to drive change, but driving change from the manufacturer down through contractors.

Difficult project economics for climate resilience, including energy storage

While energy efficiency and advanced energy management enhance a building's climate resilience, there is need and opportunity for other types of climate resilience projects, including on-site energy storage. With energy storage, residential and community buildings can be refuges during extreme weather events when the grid goes down. Energy storage can be installed alone, to be charged by the grid when it is functioning, or in conjunction with on-site renewable energy that allows for continued charging during grid failure. One example of an energy storage with solar project is the Heights Resilience Center, a community resilience hub located at the historic United Nations Beaux-Twenty Club (USO) in Petersburg. According to local resident Tamika Green, "The hub will provide heating and cooling to residents during power outages, and provide training for residents to enter or return to the workforce."[xvi] Such centers can also provide other critical services, like mobile phone charging, power for medical

devices, and medication refrigeration. Virginia would benefit from many more such resilience hubs.

Increased deployment of energy storage in Virginia will require many actions outside the scope of the CEFA, from utility planning to permitting to rate design.[xvii] Still, there are ways in which the CEFA could be supportive.

A key issue with distributed-scale energy storage is that it is still expensive: project financing often does not pencil out. Many projects, like the Heights Resilience Center, are grant funded. The RGGI-funded Virginia Community Flood Preparedness Fund is a source of funding, but funding to date has been primarily allocated toward assessment and planning efforts.[xviii] The CEFA could help spur more energy storage financing by following the lead of Inclusive Prosperity Capital[xix] and Michigan Saves[xx], and CT Green Bank[xxi], which work with partner lenders to enable affordable financing for energy storage projects.

For climate resilience projects beyond energy storage, like moving equipment from low ground to protect from flooding or installing extreme wind-resistant roofing and windows, funding is even more problematic. To be financeable, a project must have a way of paying back the upfront cost. Solar and energy efficiency projects lower utility bills, and even energy storage can lower demand charges and enable compensation for grid services. But for other climate resilience measures, repayment sources are harder to forecast and quantify. The Florida-based Solar Energy Loan Fund is demonstrating the potential to leverage reduced insurance premiums to cover the costs of financing resilience upgrades.[xxii] Other potential repayment sources include avoided post-disaster recovery costs and reduced vacancy due to enhanced resident safety and wellbeing. The CEFA could lead the way in determining how to financially account for these benefits and educate other financial institutions on best practices.

Limited capacity of small contractors

As demand for energy and resilience upgrades in existing buildings increases, the supply side of the market also needs to grow. Stakeholders indicated that well-established contractors have sufficient access to corporate financing, but small, newly established, non-profit, and/or minority- or women-owned businesses may not. These businesses would benefit from access to working capital and/or equity from the CEFA. Even for businesses that do have access to the capital they need to carry out business as usual, having access to even more attractive financing for customers they are not currently serving could help expand their customer base, including to credit-constrained customers. Providing supply-side financing is a focus of the newly established North Carolina Clean Energy Fund and is a key activity of the New York Green Bank. NY Green Bank has, for example, extended multi-million dollar lines of credit to medium-sized businesses focused on existing building retrofits.[xxiii]

Need for non-energy upgrades alongside energy improvements

A constant issue with energy performance-improving projects in existing buildings is the need for funding non-energy work that needs to be done in conjunction with retrofits, such as roof replacement and mold or asbestos remediation. It would be important for the CEFA's financing options to include an allowance for some amount of this work (e.g., up to 25 percent of a loan).

Nascent market for shared solar

Many Virginians do not own their own roof or land, and many others own a roof that is unsuitable for solar. This group includes the third of Virginia's households that are renters[xxiv] as well as residents of communities with thick tree cover that blocks solar potential (e.g., in Fairfax County, which is working to protect urban forests).

To address these barriers to solar access, shared solar advocates have successfully advocated for programs that will bolster Virginia's nascent market for shared solar, in which individuals or organizations invest in or subscribe to a solar project and get a portion of the project's output. As required under § 56-594.3 of the Code of Virginia, Dominion Energy (Dominion) is establishing a program allowing customers to buy solar power via subscription from a shared power facility owned by a third-party entity.[xxv] Initially, the program will be capped at 150 megawatts (MW) and no single project can be over 5 MW. At least 30 percent of the enrolled customers must qualify as low-income. If that subscriber bar is met, the program may add 50 additional MW. Per § 56-585.1:12 of the Code of Virginia, Dominion and Old Dominion Power are also setting up multifamily-specific shared solar programs.[xxvi]

Even with these programs established, there are financing challenges that the CEFA could help address, including by:

- Extending financing to nonprofit organizations seeking to be an equity partner in projects rather than solely earn fees as a subscriber organization;
- Financing shared solar projects directly (taking inspiration from experience at the Montgomery County Green Bank[xxvii]; DC Green Bank[xxviii]; and the Baltimore-based Climate Access Fund[xxix]); and
- Providing a loan loss reserve as a backstop for LMI subscribers who may default, thus alleviating fears that other subscribers will need to cross subsidize them.

Slow roll-out of on-bill financing programs

In a tariffed on-bill financing program, the utility or a third party financial provider provides the up-front capital for an energy efficiency project, and the utility customer pays back that capital over time via a surcharge attached to the utility meter. Under this model, debt is not held by an individual, which allows program administrators to circumvent traditional barriers to financing, like a credit check. Green banks can operate on-bill financing programs; for example, Hawaii's

green bank administers an on-bill financing program for homeowners and renters.[xxx] They can also assist in the establishment of on-bill programs by other entities, namely utilities.

Virginia's investor-owned utilities may propose tariffed on-bill programs for SCC approval. Per § 56-585.7 of the Code of Virginia, Virginia's rural electric cooperatives (co-ops) are authorized to establish these programs without SCC approval.[xxxi] As the process is easier for co-ops and there is plenty of opportunity within co-ops' service territories alone, the CEFA should focus on helping expand tariffed on-bill programs by co-ops. The first such program, being launched by Rappahannock Electric Cooperative, will initially finance residential energy efficiency projects. But the enabling legislation allows for programs to serve all member-owners, which include residential and commercial customers.[xxxii]

Stakeholders said that securing capital is not a key challenge to expanding tariffed on-bill programs across the co-op landscape: co-ops are familiar with accessing funds from USDA's Rural Energy Savings Program and (more preferably, as it tends to deploy funds more quickly) the National Rural Utilities Cooperative Finance Corporation.

Still, there are three main challenges to rapid expansion of tariffed on-bill programs the CEFA could help address:

- Co-op staff and their member-owners may not be aware of how tariffed on-bill programs work, what their benefits are (to individual member-owners and the co-op collectively), and how increased energy efficiency will impact a co-op's financials. This is in addition to any knowledge limitations of co-op staff regarding energy efficiency technologies. The Virginia, Maryland & Delaware Association of Electric Cooperatives is well positioned to partner with the CEFA on filling this knowledge gap.
- Once co-op staff and member-owners have decided to establish a program, designing and launching it takes extensive staff time and attention. For a tariffed on-bill program, this is likely done in cooperation with a program administrator, which also takes time to vet and select. A pre-vetted, opt-in statewide program could make the program start-up process easier for individual co-ops. The CEFA could sponsor such a statewide program, as Virginia Energy is doing for commercial property assessed clean energy (C-PACE).
- Most tariffed on-bill programs deal with participants' failure to pay program surcharges in the way any failure to pay is, including eventual disconnection. Concern about this possibility has stalled program development. While experience to date indicates minimal risk of disconnection in a well-designed program, the CEFA could provide a loan loss reserve to compensate co-ops for any losses from the program due to nonpayment in exchange for not disconnecting customers.

Single Family Housing

Many existing green banks are active in the residential solar, energy efficiency, and beneficial electrification market segments, with a focus on low- to moderate-income households and projects costing between $6K - $70K. Stakeholders indicated that these market segments present opportunities for the CEFA as well.

Residential building energy use, which includes both single- and multi-family housing, is responsible for 17 percent of Virginia's emissions and represents around 23 percent of Virginia's total energy use. Single-family homes (1-unit detached) is by far the largest category of housing in Virginia. Given that over half of single-family homes were constructed before 1980 and thus not built subject to modern building codes, there is tremendous opportunity to increase the energy performance and climate resilience of these buildings. Variable speed heat pumps and insulation improvements hold the greatest savings potential for these buildings. Additionally, the federal Department of Energy's Solar Futures Study reports that residential and other small rooftops represent about 65 percent of the national rooftop potential, and 42 percent of residential rooftops are LMI households, making growth of an inclusive residential rooftop solar market key to realizing overall solar market potential.[xxxiii]

The single family residential market is currently served by several types of energy efficiency and solar programs. Utility program offerings, such as the residential suites of programs offered by Dominion[xxxiv] and Appalachian Power[xxxv], include energy assessments and rebates for installed measures. Utilities also offer income-eligible programs that complement the federally funded Weatherization Assistance Program (WAP). WAP provides energy efficiency upgrades at no cost to income-qualified customers; however, it restricts the types of measures that can be installed using program funds, leading to many deferrals of homes that need non-qualified improvements before weatherization can be done. For this reason, the Department of Housing and Community Development (DHCD) is dedicating a portion of its Housing Innovations in Energy Efficiency (HIEE) program funds to a Weatherization Deferral Repair program, which completes that work needed on deferred homes and allows for weatherization to proceed. Virginia's Clean Energy Advisory Board (CEAB) is developing a program that will increase deployment of solar amongst LMI households using the Low-to-Moderate Income Solar Loan and Rebate Fund.[xxxvi] Localities and nonprofit organizations also offer residential services, like energy assessments and Solarize campaigns.

Generally, households qualify for income-eligible programs if they have a total household income under 80 percent of local median income per the Virginia Housing Development Authority, or under 60 percent of the state median income per the Virginia Department of Housing and Community Development, whichever is greater. Income-qualified programs are a cornerstone of more equitable access to energy efficiency and solar, but there are many households that do not qualify yet still struggle to access other funding or financing for projects.

This is a gap in the current funding and financing landscape that many localities are struggling with.

Given resources available to households with incomes under 60 percent of the state median income, stakeholders highlighted the opportunity for the CEFA to focus on households with income between 60-120 percent of state median income. These households receive less dedicated resources but do not have disposable income to devote to energy projects with multi-year payback periods. Doing so could help drive uptake of utility program offerings by single family households in this income band. Financing energy efficiency projects for these households would also enable their receiving solar funding from the LMI solar program under development by the CEAB, for which undergoing an energy efficiency retrofit is a prerequisite and households at or below 80 percent of the state median income are eligible.

There are a growing number of LMI-accessible residential financing programs across the country that the CEFA could adopt in whole or in part, including Inclusive Prosperity Capital's Smart-E Loan[xxxvii], the Hawaii Green Infrastructure Authority's Green Energy Money $aver (GEM$) On-Bill Program[xxxviii], the Solar and Energy Loan Fund's Home Improvement Loan[xxxix], the National Energy Improvement Fund's EnergyPlus Home Improvement Financing Program[xl], and the New York State Energy Research and Development Authority's suite of residential financing options[xli]. While extending financing to moderate-income households still comes with the challenge of monthly payments and risks related to nonpayment, the CEFA could apply emerging best practices to mitigate risks, like on-bill financing and the deferred payment loan model[xlii].

Multifamily Housing

The multifamily housing sector is large and diverse. At the highest level, it is broken into occupant-owned (condominium) and rental properties. Multifamily rentals can be broken into market-rate and affordable. Within the affordable multifamily housing sector, properties can either be naturally occurring affordable housing (affordable to households with moderate income without government subsidies) or government-subsidized. Subsidized properties can be either publicly owned or privately owned. In most multifamily housing scenarios, utilities are paid for by the resident rather than the property owner.

Residents of all multifamily housing properties can benefit from upgrades to their buildings. A 2017 report by the Virginia Multifamily Energy Efficiency Coalition describes the significant potential of energy efficiency in multifamily housing as well as unique barriers the sector faces to realizing that potential.[xliii] Key barriers include complex building ownership and financing structures, access to utility data for multiple accounts, utility payment arrangements (the split incentive), and high upfront cost. Because of the large opportunity for but challenges to realizing multifamily energy upgrades, many existing green banks support multifamily energy efficiency, solar and storage, and electrification projects costing $150K - $30M.

For the sector broadly, there are many properties every year that are undergoing acquisition or substantial rehabilitation in conjunction with a major financing event. These events are key opportunities to integrate energy and climate resilience upgrades into larger scopes of work because the cost of mortgage capital is low-cost and long-term and key stakeholders' attentions are focused on property improvements. Government efforts can help ensure that energy and climate performance are assessed and improvements are financed at these events. The CEFA could provide funding for assessments (conducted in conjunction with a capital needs assessment) or provide credit enhancements for "green mortgages" extended by private financial institutions. Based on program experience to date, a key element of a successful green financing program for properties at a major financing event is the seamless integration of the "green" financing within the mortgage financing process.[xliv]

Major financing events for multifamily properties occur infrequently (around every 10-15 years), so there is a need for green financing solutions for properties between such events, or "mid-cycle". To promote more mid-cycle retrofits in multifamily properties, the CEFA could provide credit enhancements to financial institutions offering long-term loans, bridge financing to help borrowers take advantage of incentives that are not disbursed until a project is completed, and gap financing for health- and safety-related work that must be completed before energy upgrades can be made.

All multifamily buildings will need to be served either at a major financing event or mid-cycle. As projects are completed, the CEFA could play the important role of collecting and disseminating data on the performance of completed projects to build market awareness of and confidence in the opportunity. But where in the multifamily housing sector a property is situated presents unique barriers to financing energy and resilience projects, and thus unique opportunities for the CEFA to address those barriers. Those specifics are outlined below.

Privately Owned Affordable Multifamily Housing

There are many energy-related programs currently serving the private multifamily affordable housing sector. First, utility programs. Dominion's multifamily program is open to all multifamily properties, market-rate and affordable.[xlv] The program offers customers an energy audit, a report with recommended energy-saving improvements for tenant units as well as common areas, and rebates that cover some of the cost of many measures. Unfortunately, the program does not cover the cost of the audit, which can be expensive and is required to access measure-specific rebates. Appalachian Power's Low Income Multifamily Program is designed for affordable multifamily properties specifically and also offers an energy audit, report with recommendations, and rebates.[xlvi] Importantly, the program covers the cost of the audit and provides funds for limited incidental repairs needed to make weatherization improvements.

In addition to utility-sponsored programs, the two main programs that finance energy projects in privately owned affordable multifamily housing are the Low Income Housing Tax Credit (LIHTC) program administered by Virginia Housing and the Housing Innovations in Energy Efficiency (HIEE) program administered by DHCD. The LIHTC program is a federally funded (and highly competitive) program that enables tax equity financing typically for new construction and rehabilitation projects in exchange for properties' remaining affordable for at least 15 years. Virginia's guidance establishing eligibility priorities and criteria for awarding federal tax credits (the Qualified Allocation Plan) has requirements as well as optional additional points for high energy performance.

HIEE is funded through Regional Greenhouse Gas Initiative (RGGI) proceeds.[xlvii] To date, multifamily-focused funding has been allocated through DHCD's Affordable and Special Needs Housing (ASNH) program. The ASNH program provides gap financing for building new or preserving existing affordable housing units, the vast majority of which also receive LIHTCs. HIEE incentivizes efficiency beyond what is required for LIHTC.

In this context of existing programs, stakeholders suggested that privately owned, subsidized affordable multifamily housing properties have a relative abundance of resources available for energy performance improvements. There is opportunity for additional resources to be directed toward the unsubsidized, "naturally occurring" affordable multifamily housing that generally consists of smaller properties. These smaller properties are often owned by small companies with very limited staff capacity and relatively limited access to financial resources.

To serve this unsubsidized multifamily sector, the CEFA could look to offerings from CT Green Bank's Multifamily Program[xlviii] as well as DC Green Bank's participation in the DC government's Affordable Housing Retrofit Accelerator[xlix]. Both entities offer pre-development and construction financing streamlined with incentives and technical assistance offered by other government entities.

Additionally, there is a lack of resources specifically for financing solar (and especially solar with energy storage) in multifamily properties. HIEE has had an abundance of funding to date, but may only be directed toward energy efficiency-related work. The CEFA could bring the successes of existing multifamily solar and energy storage financing offerings, including those of the NYC Energy Efficiency Corporation[l] and DC Green Bank[li], to Virginia.

Publicly Owned Affordable Multifamily Housing

Stakeholders emphasized that Virginia's public housing stock, which totals about 15,000 units, is old and underperforming. These properties are "non-jurisdictional" utility customers, so they cannot access utility programs. Restrictions on the use of HIEE funds has made it difficult to develop a strategy for using those funds to improve energy performance of public housing, though it may be considered again in the future. If HIEE is not able to meet this need, the CEFA

could work with Public Housing Authorities (PHAs) to design an offering, such as a pre-development loan and construction loan package with technical assistance, that enables them to do so. This would be especially beneficial for smaller PHAs with limited staff capacity and access to competitive funding sources.

Condominiums

In Virginia's more urban geographies, there are large numbers of market rate high-rise buildings with either rental units or condominiums, and there are significant barriers to making energy improvements in both. Retrofitting condominiums is challenging in part because of their fragmented ownership structure: it is incredibly difficult for a group of homeowners to achieve the necessary approval for retrofitting work. They often lack information about who to contact and shy away from or get trapped in the collective decision making process. Additionally, contractors and financiers are not usually prepared to work with or finance multiple owners, preferring multi-unit buildings with one owner. Opportunities for the CEFA to address these barriers are less clear, but lessons can be learned from Montgomery County Green Bank's experience in this market.[lii]

Non-Multifamily Commercial Buildings

The commercial building sector has numerous sub-segments characterized by size (square footage) and use type (e.g., retail, hotel). The top three building types in Virginia by energy consumption are office (30 percent), retail (29 percent), and non refrigerated warehouse (15 percent). Altogether, commercial buildings are responsible for 18 percent of Virginia's emissions and represent around 26 percent of Virginia's total energy use.

There are many large office buildings that are major energy users, especially in Virginia's urban centers. It is crucial that these buildings undergo efficiency retrofits, electrify, and shift to using renewable energy. Many of these buildings are good candidates for existing commercial-sector green financing products best suited for projects costing over $250K, including energy savings performance contracts and C-PACE. C-PACE is set to expand in Virginia with the establishment of a statewide, voluntary opt-in program in 2022.[liii] Therefore, stakeholders indicated that the CEFA should direct its resources toward the small- and medium-sized buildings segment of the commercial building sector.

Because of nationwide challenges related to improving energy performance of small and medium commercial buildings (SMBs), many U.S. green banks operate in the "sub-PACE" market, enabling projects costing around $50K - $250K in buildings of around 10K - 50K square feet. While individual projects can and often should include a combination of energy efficiency, solar, and other technology components, the sections below highlight technology-specific challenges the CEFA could help address in collaboration with partners already connected with SMBs, such as the Virginia Small Business Financing Authority (VSBFA).

Energy Efficiency

According to stakeholders, the first challenge with expanding uptake of energy efficiency in SMBs is a (perceived, at least) lack of companies focused on marketing energy efficiency projects. One specialized clean energy lender said their firm would be happy to finance efficiency projects, but almost all of their loans are for solar projects because the lender relies on contractors for business development, and solar companies are more actively marketing. Without concerted efforts to originate energy efficiency projects, they do not materialize. The CEFA could work with private lenders and/or the VSBFA to provide financing that matches energy cost savings to loan payments, as Montgomery County Green Bank does through its CLEER Loan program.[liv] Through such a program, the CEFA, participating lenders and contractors, and other partners would work together to market the program and originate projects.

The second challenge raised by stakeholders is the limited secondary market for small commercial energy efficiency loans. This is due to a lack of project and contract standardization and the burden of an entity keeping loans on their balance sheet until there are enough to be securitized. The CEFA could assist with both issues by promoting standardization as well as by buying small loans from other entities, aggregating and warehousing them, and then securitizing them. There could be an arrangement through which the VSBFA serves as the securitizing entity, given its existing bonding authority.

Solar

Small commercial solar projects (50KW - 200KW) can be financed via a power purchase agreement (PPA)[lv], through which a third party owns the system, or a solar loan, through which the customer owns the system. The expanded allowance of PPAs under the Virginia Clean Economy Act has been instrumental to expanding small commercial solar projects; however, there is room for improvement the CEFA could help realize.

Solar companies can use their own capital to finance PPAs, but that ties up capital and limits project capacity. To avoid this, mature companies have relationships with commercial banks and institutional investors for access to additional capital. Smaller, less established companies usually cannot establish these relationships. To promote the growing solar sector, the CEFA could enable the provision of capital to smaller solar companies, either by extending it directly or enabling its provision by the VSBFA and/or private financiers.

Similarly on the customer side, stakeholders suggested the CEFA should focus on enabling projects for smaller entities (e.g., nonprofit organizations) that may not be able to warrant investor-owned PPA projects due to small project size and guarantee requirements. Inclusive Prosperity Capital's Solar PPA Loan[lvi] as well as the catalytic capital solutions being pursued

jointly by the Appalachian Solar Finance Fund and Invest Appalachia Fund[lvii] could serve as inspiration.

While many commercial customers prefer PPAs because they make solar payments an operating expense instead of on-balance sheet debt, others prefer to finance via loans. These loans can be provided via traditional or specialized clean energy lenders. According to stakeholders, lenders are currently able to meet demand for solar loans, so the question is how to spur greater demand for them. As such, the same solutions can apply here as for SMB energy efficiency. For example, the CEFA could provide an interest rate buy down, in which it would provide a grant to lenders to reduce the interest rate given to customers without reducing lender compensation. And as with energy efficiency, the CEFA could play the important role of facilitating connections between participating lenders and contractors.

Transportation

The transportation sector is responsible for 35 percent of Virginia's emissions, with on-road transportation contributing 29 percent and off-road mobile sources contributing 5 percent. Shifting to a cleaner transport sector will require transitioning to electric vehicles (EVs), improving the EV charging network, moving to cleaner sources of electric generation, and reducing vehicle miles traveled, among many other actions state and local governments can take.[lviii] As with electrified buildings, greenhouse gas emissions of electric vehicles will decrease as the Commonwealth moves toward a carbon-free grid. EVs can even play an important role in enabling the shift to a carbon-free grid by providing energy storage services when not in use.

Numerous policies and regulations are already in place to facilitate the transformation of transportation. For example, clean car standards adopted in 2021 and effective in 2024 will require auto manufacturers to increase the number of electric and plug-in hybrid vehicles they sell to auto dealers in the state and set more stringent limits on tailpipe emissions. Virginia Energy has operated several state and regional planning and deployment projects, including the Mid Atlantic Electrification Partnership focused on deploying charging stations and vehicles. Plus, significant public investment has been and continues to be made in Virginia's clean transportation system, including via the Department of Environmental Quality's administration of the $93 million Volkswagen Environmental Mitigation Trust.[lix]

Stakeholders noted that despite the significant public funds being channeled into transportation's transition, it is a drop in the bucket of what is needed for full transformation. For EV charging infrastructure specifically, the most pressing challenges to its build-out are not currently financing related, and financing will be increasingly available as electric utilities become more involved and as Virginia receives an additional $106 million in charging funding due to passage of the Infrastructure Investment and Jobs Act.[lx] Most green banks do include EV chargers as an eligible measure for financing, and the CEFA could do the same for its products. But rather than focus on EV charging, stakeholders suggested that the CEFA would be best

positioned to aid in accelerating the deployment of personal EVs and medium and heavy duty fleet EVs for which expanding end-user access to private financing is more critical.

Personal EVs

Most personal vehicle buyers get financing through their auto dealer. This presents a first challenge to greater EV deployment, as dealers may not be incentivized to sell EVs that require less future maintenance from the dealer. Second, electric energy for transportation could cost retail consumers around $1 per gallon equivalent, and be far lower for municipal and larger customers, but upfront EV prices are still relatively higher than gasoline-fueled vehicles. This especially impacts EV access for consumers with lower credit scores who face challenges accessing financing generally.

There is a federal income tax credit for up to $7,500 for the purchase of a qualifying EV or plug-in hybrid and another credit of up to 30 percent or $1,000 for charging station equipment. Lower income consumers may not be able to take advantage of the federal EV tax credit without help bridging the gap from purchase to receipt of the tax refund (assuming they have sufficient tax liability to monetize it at all). The CEFA could partner with auto financing providers to not only make financing for EVs especially attractive, but also make that financing accessible to lower-credit consumers. Some banks, such as Everence Federal Credit Union[lxi], are already providing special financing for EVs, and the CEFA could help make this more widespread. Such a product should involve bridge financing for EV tax credits, cover both the new and used EV markets, and be promoted especially in rural areas.

The CEFA could track information about the evolving EV market that will make private financiers even more comfortable lending, such as on residual value and operational performance. Because EV fuel costs may be far lower than for non-electric vehicles, the CEFA could also recognize that additional capacity to pay when extending EV financing to borrowers.

Medium and Heavy Duty Fleet Electrification

Stakeholders emphasized the need for additional public support for electrification of medium and heavy duty (MHD) fleet vehicles (e.g., utility vehicles, school buses, and transit buses). MHD fleet electrification is particularly beneficial from a human health and environmental justice perspective. These diesel-powered vehicles emit harmful local pollutants, including nitrogen oxides and particulate matter, that are concentrated low to the ground, at a child's breathing height. Research from the University of Virginia demonstrates that diesel emissions disproportionately impact communities of color.[lxii] All-electric vehicles, on the other hand, have zero tailpipe emissions. Virginia took a significant step forward on accelerating electric MHD vehicle deployment when it signed onto the Multi-State Medium- and Heavy-Duty Zero Emission Vehicle Memorandum of Understanding with 15 other states and D.C.[lxiii]

Scale in manufacturing and falling battery costs are causing vehicle prices to fall quickly, but still the key challenges to broader deployment are price and procurement complexity. The upfront cost of an electric MHD vehicle is often two to four times higher than the diesel alternative, and buyers must also acquire, install, and operate the necessary charging infrastructure. This is an intimidating and expensive task for an individual looking for a personal EV, not to mention for an individual managing a fleet of vehicles. Electric fleets are expected to cost less in maintenance and fuel over their lifetimes, often having a lower total cost of ownership over their lifetime. Adding solar with energy storage amplifies the savings opportunity by reducing the operators' utility demand charges. But savings on operational expenditures over a vehicle's lifetime does not mitigate the challenge of meeting the large upfront capital expenditure required for fleet conversion, which is even greater with solar and storage. This is especially challenging for smaller fleet operators with limited access to capital.

DEQ, the Virginia Port Authority, and investor-owned utilities have grant programs that cover the differential between diesel and electric options for school and other transit buses, port vehicles, waste management trucks, and other fleet vehicles. Within MHD fleets, electric school buses (ESBs) have received particular attention. DEQ's Clean School Bus program provides rebates up to $300,000 for the incremental costs of ESBs and their customer-side charging infrastructure.[lxiv] Dominion's electric school bus program has provided vehicles and installs charging infrastructure for schools that received DEQ's Clean School Bus grants.[lxv] Appalachian Power is also providing grants for ESB deployment.[lxvi] By mid-2021, DEQ had supported deployment of 83 ESBs.[lxvii] These efforts are critical to catalyze transition by proving the ESB concept, but much work remains: there are around 13,000 school buses in Dominion's service territory alone.

MHD fleet electrification is a major area of opportunity for the CEFA because of the large volumes of financing needed to transition fleets at scale. Most obviously, the CEFA could finance fleet purchases for smaller operators, with the financing integrating available government and utility grants. The CEFA could lead the way in underwriting the future savings on maintenance and fuel costs, improving the financial viability of EV conversions. It is notable that some MHD EV companies are offering turnkey offerings through which they design, provide, and maintain the fleet in exchange for an annual lease payment. This is a promising model, and the CEFA could support its uptake by financing the leases, if there is need.

Industry

The industrial sector is responsible for 18 percent of Virginia's emissions, tied with commercial building energy use and second only to on-road transportation. The sector includes industries whose emissions are particularly hard to abate, including steel, cement, aluminum, and chemicals. These industries tend to rely on high-heat processes or energy-dense fuels that have been difficult to substitute affordably to date with low-carbon alternatives. Additionally, some chemical processes (e.g., lime manufacturing) emit significant amounts of carbon dioxide

as a result of their production chemistry. These emissions, termed process emissions, make up around a third of Virginia's industrial emissions and are difficult to avoid. Despite the unique challenges to shifting to cleaner energy sources and production processes in this sector, consumer preferences and supply chain sustainability efforts are forcing all manufacturers and other industrial actors to explore lower-carbon opportunities.

Leading companies are stepping forward with plans that take advantage of new clean technologies.[lxviii] The U.S. DOE's Loan Programs Office (LPO) is actively seeking to use some of its $40 billion in loan and loan guarantee authority to help commercialize them. The average size of an LPO transaction is around $750 million. Because green banks tend to focus on scaling of commercialized technologies and smaller transactions, green banks have not been active in the industrial sector to date; however, stakeholders did identify industrial-sector opportunities for the CEFA in Virginia.

A specific opportunity raised by stakeholders is to help small manufacturers access solar. Small manufacturers are increasingly interested in accessing solar due to demands from large buyers working to green their supply chains. The CEFA could assist these small customers in financing their own projects (via PPA or solar loans) or help them buy into a larger shared project (by providing a credit enhancement, for example).

Another opportunity is to invest in new industrial companies that arise as part of the growing clean energy economy. These companies, from battery manufacturers to green building component manufacturers, will need equity and working capital. They may need assistance in taking advantage of existing green manufacturing tax credits, which the CEFA could provide via bridge financing. However, given these new (or expanded) companies' contribution to economic development, serving this need may be better suited to existing economic development-focused financing entities.

Focus on Rural Opportunities

In addition to the opportunities outlined above, there are many opportunities for the growth of the clean energy industry and increased climate resilience to benefit rural communities specifically. They include agricultural efficiency and solar irrigation, improved energy performance of rural homes, brownfield solar, and deployment of distributed wind.

Agricultural Efficiency and Solar Irrigation

According to the Virginia Department of Agriculture and Consumer Services, agriculture is Virginia's largest private industry by far, contributing enormously to Virginia's total economic output and jobs.[lxix] The sector uses energy directly to run machinery, equipment, and buildings and indirectly via use of fertilizers. There is great opportunity for farmers to save on energy

costs. One way for farmers to reduce energy costs is to shift to high-efficiency or electric equipment.[lxx] Dominion is launching an agricultural efficiency program that will provide customers with technical assistance and rebates for installing certain high-efficiency equipment, and the CEFA could complement this program by extending or facilitating attractive financing for those projects. Given Virginia's thousands of livestock and poultry farms, capturing and selling biogas produced by agricultural processes presents another opportunity. The CEFA could finance biogas systems for entities that are large enough to justify such a system but lack affordable financing options, as New York Green Bank has done.[lxxi] Importantly, the CEFA would need to ensure that projects use the advanced technologies necessary to ensure projects do not have negative impacts (public health or otherwise) on surrounding communities. Lastly, the CEFA could provide financing support for farmers' use of solar irrigation, working in partnership with the Virginia Cooperative Extension.

Improved Energy Performance of Rural Homes

Research conducted in 2019 by ACEEE and the Energy Efficiency for All (EEFA) coalition found that rural households spend 4.4 percent of household income on home energy bills, which is one-third higher than the median percentage nationally.[lxxii] The report found that rural households with low incomes are further burdened, spending 9 percent of income on home energy bills. Drivers of this high energy burden, aside from lower income, include poor physical condition of homes, barriers to investing in energy efficiency upgrades that would lower this energy burden, and unavailability of programs that would help address barriers to completing such upgrades.

As an additional benefit, energy efficiency has specifically shined as a source of economic activity in rural areas. As part of an economic transition initiative in the coal town of Centralia, Washington, energy efficiency projects created 3-4 times as many jobs as renewable energy or even mining.[lxxiii] Because of the labor intensiveness of efficiency projects, energy efficiency grant recipients spent three times more on hiring laborers than did renewable energy recipients, and these funds were more likely to go to local workers. Any CEFA efforts focused on the residential sector should include strategies for reaching rural households specifically, including by partnering with rural community action agencies and other community-based organizations.

Brownfield Solar

Virginia has significant opportunity for commercial scale solar development on brownfields (i.e. former industrial or commercial sites, such as landfills), and on former mine lands in particular. Such projects utilize land that is already disturbed rather than developing land on which solar would conflict with other important uses, such as wildlife habitat, forestry, carbon sequestration, and recreation. Projects can feed the general electric grid or can serve specific facilities, as in the case of a solar project serving Wise County's Mineral Gap Data Center.[lxxiv] Recognizing the

advantages of developing solar projects on brownfields, Virginia policymakers have instituted a simplified permitting process for them.[lxxv]

Stakeholders indicated that due to geotechnical and other issues with development on former mine lands, brownfield solar projects cost significantly more than a greenfield project. Private financiers may be less likely to finance these projects due to heightened complications and thus risk. The Virginia Abandoned Mine Land Economic Revitalization program, which aims to boost economies in Virginia's coalfield region and is administered by Virginia Energy, has provided funding for solar projects, but there are many attractive uses for those limited funds.[lxxvi] The Virginia Brownfield & Coal Mine Renewable Energy Grant Fund was established in 2021 to bolster renewable energy projects specifically, but it has not been funded.[lxxvii]

In considering how the CEFA might help address barriers to faster deployment of solar on brownfields, inspiration can be taken from the Rhode Island Infrastructure Bank's Brownfields Revolving Loan Fund.[lxxviii] The Fund makes financing available to public, private and non-profit borrowers for the remediation of properties contaminated with hazardous substances. The Infrastructure Bank manages the Fund in partnership with the Department of Environmental Management (DEM). The CEFA could extend such financing in partnership with appropriate agencies, ideally to complement grants from a funded Brownfield & Coal Mine Renewable Energy Grant Fund.

Distributed Wind

While Virginia's overall wind resources are modest, there is relatively high potential for distributed wind in rural areas, including the mountainous southwest, along the eastern shore, and the southside.[lxxix] Distributed wind provides a useful complement to utility-scale renewable energy in places where there are land conflicts with agriculture, recreation, or other uses. Systems tend to be behind the meter, used onsite by the system owner.

While there is interest in growing this renewable energy market segment, upfront cost is a barrier. To date, USDA's Rural Energy for America Program has been the primary source of grants and financing for projects. Given the opportunity but relative anonymity of this generation technology, the CEFA could partner with James Madison University's Distributed Wind Assistance Program[lxxx] to raise awareness of it amongst rurally focused lenders, assist landowners in accessing available federal funding, and potentially extend or facilitate financing.

Working with Localities

Localities without Local Green Banks

Stakeholders stressed that if the CEFA were established, localities without a local green bank should not be mandated to participate or partner with it in specific ways, but rather be given the option to do so. Such partnership would be important to the success of the CEFA, given the invaluable perspective on needs and outreach infrastructure held at the local level.

There are many ways in which localities could interact with the CEFA that would leverage the strengths of each entity. The CEFA and localities could work together to design products and programs, with a formal annual consultation process or locality advisory body established to ensure ongoing communication. The CEFA could conduct all project processing and underwriting, manage contractor training and vetting for consistency and to ensure consumer protection, and develop marketing materials, with localities leading on local outreach and awareness building. One stakeholder suggested that the greatest impact would result from local governments hiring one or more staff dedicated to closing deals under CEFA programs in their jurisdiction, leveraging the scale of a statewide program with the on-the-ground benefit of local staff. Of course, localities will be instrumental in directing how CEFA resources would be best deployed in coordination with any existing local programs.

Localities with Local Green Banks

While the green bank model originated on the state level, green banks now exist on the county and city level as well. Local level green banks can serve the important role of piloting products and services that can later be scaled by a statewide entity. This has been the case in Maryland, which is home to the Montgomery County Green Bank (county-level) as well as the Maryland Clean Energy Center (statewide).

Existing local-level green banks include New York City Energy Efficiency Corporation (which was established as exclusive to NYC but now operates in eight states and Washington, D.C.), Montgomery County Green Bank in Maryland, DC Green Bank, and most recently the Philadelphia Green Capital Corporation. The District's green bank serves the smallest resident population of around 700,000.

The largest county in Virginia is Fairfax County, with a population of over 1.5 million. This is more than double the size of the next largest county, Prince William County, with a population of around 480,000.[lxxxi] A local-level market assessment in any Virginia locality interested in a local green bank will inform the feasibility of a successful entity based on the addressable market.

Capitalization Sources

Green banks may be capitalized by state or local budget appropriations, federal programs (e.g., Department of Energy, Department of Agriculture), fees paid by electricity consumers, proceeds from emissions trading or a carbon tax, green bond issuance, proceeds from utility or other settlements, crowdfunding (e.g., via green liberty bonds[lxxxii]), philanthropic grants or program-

related investments, or even private entities that have an interest in the deployment of projects a green bank would promote (e.g., healthcare providers).

To a great extent, the types of products and services a green bank can offer depends on the source and scale of as well as financial return requirements on its capital. Certain funds may be dedicated for specific market segments. A smaller capital base might best be used as credit enhancements for de-risking private lenders. A larger pool of capital is required for a green bank to serve as a direct lender or participant in transactions. Market development services such as public awareness and outreach, workforce development, and market research and information dissemination are best enabled by access to funding that does not demand a financial return.

Green banks do not require ongoing state funding to remain solvent. The only green bank that has on-going funding is CT Green Bank, and that is by design: its creators had identified annual funding streams (e.g., RGGI proceeds), so the organization was designed to suit that financial model. Green banks have sought additional public (state and federal) and philanthropic funding not because they have become insolvent, but to expand their operations, especially into challenging market segments that require significant technical assistance and generate less revenue.

Conclusion

Virginia already has a strong clean energy economy, with a large clean energy workforce and several billion dollars of economic activity annually. And while there are many existing options for funding and financing clean energy, clean transport and climate resilience projects in Virginia, there remain barriers to realizing these markets' full growth potential. Addressing the barriers to growth of key market segments through the strategic deployment of public resources under a statewide green bank (i.e., the Commonwealth Clean Energy Financing Authority, or CEFA) would leverage several dollars of private investment in Virginia's economy for each public dollar deployed. It would open up new market opportunities for the robust set of clean energy businesses already operating in Virginia, attract new such businesses to the Commonwealth, and help reduce rather than increase Virginians' utility bills during the energy transition, among other benefits.

While localities are currently authorized to establish green banks, practical challenges to doing so risks that only larger, mostly urban localities will pursue the opportunity. Establishing a state-level CEFA would ensure that localities across the Commonwealth, including and especially rural localities, would benefit from the increased private investment the CEFA would mobilize. Virginia neighbors Maryland, Washington, D.C., and North Carolina have taken this step. If the CEFA were established, localities without a local green bank should not be mandated to participate or partner with it, but rather be given the option to do so.

This preliminary market assessment found that specific market segments in which the CEFA could help fill financing gaps include: energy efficiency, solar, climate resilience, and

electrification in the existing buildings sector; and specifically in moderate-income single-family homes, naturally occurring affordable housing, and small commercial buildings; deployment of personal EVs and electrification of medium and heavy duty fleet vehicles in the transportation sector; and solar access for small manufacturers and financing for new clean technology manufacturers in the industrial sector. In rural communities specifically, there is additional opportunity for the CEFA to advance agricultural efficiency and solar irrigation, brownfield solar, and distributed wind as well as reduce disproportionately high energy burdens for rural households.

Across each these priority market segments, the CEFA could help accelerate market growth by conducting marketing and outreach; providing impartial guidance to consumers; serving as a resource for quality contractors and lenders; providing or facilitating the provision of easy, low-cost, and standardized financing; promoting alternative underwriting to expand access to financing; and gathering and disseminating information to the market and policymakers. To a great extent, the specific products and services the CEFA could offer depends on the source and scale of its capitalization as well as its financial return requirements.

The existing landscape of financing options for and key challenges to clean energy, clean transport, and climate resilience projects are constantly evolving. For that reason, it is important that any program or entity that aims to fill financing gaps has the flexibility to itself evolve in response. Fortunately, widespread adoption of the green bank model nationally has resulted in a suite of reality-tested green bank products, programs, and program implementers Virginia could tap into, should it decide to establish a Commonwealth Clean Energy Financing Authority. Doing so would situate the Commonwealth in a growing group of states poised to capture the tremendous economic opportunities presented by the global growth of clean energy markets.

Appendix: Landscape Analysis

Existing Funding and Financing Options

In considering the establishment of any new clean energy, clean transport, or climate resilience financing program, whether under the CEFA or some other entity, it is important that such a program complement rather than duplicate or compete with existing funding and financing options offered by public and private entities. A non-comprehensive list of key public and private funding and financing sources available in Virginia is below.

- U.S. Department of Agriculture Rural Energy for America Program
- U.S. Department of Energy Loan Programs Office
- Housing Innovations in Energy Efficiency program
- Low-to-Moderate Income Solar Loan and Rebate Fund
- Virginia Community Flood Preparedness Fund
- Virginia Volkswagen Mitigation Trust
- Electric Vehicle Rebate Program
- Virginia Energy Management Program: Energy Performance Contracting
- Virginia Resources Authority programs
- Virginia Small Business Financing Authority programs
- Virginia Abandoned Mine Land Economic Revitalization program
- Virginia Coalfield Economic Development Authority Renewable Energy Fund
- Southwest Virginia Energy Research and Development Authority Fund
- Appalachian Solar Finance Fund
- Invest Appalachia Fund
- Virginia Brownfield and Coal Mine Renewable Energy Grant Fund and Program
- Commonwealth Energy Fund
- Ratepayer-funded utility programs
- Private financing via traditional loans and leases, including via Community Development Financial Institutions
- Private financing via specialized financing vehicles (e.g., power purchase agreements and commercial property assessed clean energy)

Energy and Emissions Profile

As of 2019, transportation was the largest energy consuming sector in Virginia, consuming around 33 percent of the total. The residential and commercial sectors consumed around 23 percent and 26 percent respectively (meaning that together, buildings actually consumed the most at 49 percent of the total).[lxxxiii] The industrial sector consumed the remaining 18 percent. Each sector consumes both electricity and natural gas directly, with the residential and commercial sectors consuming more electricity than natural gas while the industrial sector consumes more natural gas than electricity.

Within the electricity sector, in 2020 natural gas accounted for 61 percent of Virginia's utility-scale electricity net generation, nuclear supplied 29 percent, renewables (mostly biomass) provided 6 percent, and coal fueled less than 4 percent.[lxxxiv] Virginia is in the process of retiring existing coal-fired power plants, with all but one plant expected to cease operation in 2024 (the

Virginia City Hybrid Energy Center is slated to remain operational until 2045). The Virginia Clean Economy Act includes a target of shutting down all carbon emitting power plants by 2045. In November 2021, the Virginia Department of Environmental Quality (DEQ) published the summary results of its economy-wide greenhouse gas inventory, which uses 2018 data.[lxxxv] The inventory breaks down the emissions contributions by sector as: 29 percent on-road transportation, 5 percent off-road mobile sources, 18 percent industry, 18 percent commercial energy, 17 percent residential energy, 5 percent energy production, 5 percent agriculture, 2 percent solid waste, and less than 1 percent wastewater.

Building Stock and Energy Savings Potential

Analysis conducted in 2017 by the Electric Power Research Institute found that Virginia's total energy efficiency economic potential in 2035 is 17.5 - 20 percent of adjusted baseline sales, among the highest in the country. As of 2017, however, Virginia had made less than 20 percent progress to achieving that potential, less than all of its neighbors.[lxxxvi] The residential and commercial sectors have the highest efficiency economic potential, with industry having less.[lxxxvii]

Residential

There are around 3.5 million total housing units in Virginia, with those units most concentrated in northern Virginia, Hampton Roads, Richmond and surrounding counties, Albemarle County, and Roanoke city. Around 47 percent of housing units were constructed before 1980 and thus not built subject to modern building codes.[lxxxviii]

Virginia's owner-occupied housing unit rate is 66 percent.[lxxxix] A large majority of homes are 1-unit detached homes, and these homes use both electricity and natural gas. For single family homes, the measure with the greatest electricity savings potential is upgrading electric furnaces with variable speed heat pumps at wear out, followed by improved wall insulation.[xc] The measure with the greatest fuel savings potential is improved wall insulation.[xci]

Commercial

The U.S. Department of Energy (DOE) has developed a tool for assessing the energy savings potential in commercial buildings based on data from DOE's 2019 Commercial Building Inventories and the 2012 Commercial Building Energy Consumption Survey.[xcii] The tool's analysis finds that there are around 79,000 commercial (including multi-family) buildings in Virginia. The top three commercial building types by number of buildings are retail (25 percent), office (24 percent), and non refrigerated warehouse (11 percent). The top three building types by floor area are multifamily (30 percent), office (17 percent), and non refrigerated warehouse (15 percent).

In terms of energy consumption, the top three building types are office (30 percent), retail (29 percent), and non refrigerated warehouse (15 percent). These buildings use primarily electricity and natural gas. According to the tool, the retrofit technology with the greatest energy savings potential (including for office and retail building types) is a rooftop heat pump followed by LED lighting, while the technology with the greatest financial savings potential is LED lighting followed by a rooftop heat pump. Importantly, the greatest energy and financial savings for any commercial building type results from a combined retrofit including several technologies.

Energy Burden

The U.S. DOE's Low-Income Energy Affordability Data (LEAD) tool provides data on Virginians' energy usage and as well as energy burden, or the percentage of gross household income spent on in-home energy costs.[xciii] The tool shows a clear association between income and energy burden: lower incomes are associated with higher energy burden, with the greatest energy burdens being shouldered by households in the lowest income band. Within each income band other than the highest (over 100 percent of area median income, or AMI), owner-occupied households tend to have a higher energy burden than renter-occupied households.

The national average energy burden for non-low-income households is around 3 percent.[xciv] In Virginia, there are around 34,600 owner-occupied single family homes with an annual income at or below 80 percent of AMI with an energy burden of 11 percent or greater. Across home ownership types and heat source, Virginia has over 665,000 households with an energy burden over 6 percent.[xcv] Electricity costs are especially high relative to natural gas for all income bands.

The LEAD tool highlights that mobile homes have the highest average energy burden of all residential building types and that geographically, the highest energy burdens are concentrated in Southwest Virginia, South Central Virginia, and the Eastern Shore. Data is lacking on the impact of race on energy burdens across Virginia.[xcvi] A 2020 analysis by the American Council for an Energy-Efficient Economy (ACEEE) found that nationally, the median energy burden for Black households is 43 percent higher than for non-Hispanic white households (4.2 percent versus 2.9 percent), and the median energy burden for Hispanic households is 20 percent higher than that for non-Hispanic white households (3.5 percent versus 2.9 percent).[xcvii]

While many Virginians currently suffer under heavy energy burdens, addressing the energy inefficiency of buildings contributing to this reality presents an opportunity. In fact, a separate analysis by ACEEE found that Virginia's low-income households have electricity savings potential of around 30 percent.[xcviii]

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[i] "Clean Jobs America 2021." E2, https://e2.org/wp-content/uploads/2021/04/E2-2021-Clean-Jobs-America-Report-04-19-2021.pdf.
[ii] "Modeling Decarbonization: Report Summary and Policy Brief for Virginia Governor's Office Administration and Policymakers." Virginia Department of Energy, December 2021, https://rga.lis.virginia.gov/Published/2021/SD17/PDF.
[iii] "The Clean Energy & Sustainability Accelerator: A Record of Bipartisan Support at the State Level." Coalition for Green Capital, https://coalitionforgreencapital.com/wp-content/uploads/Bipartisan-Support-at-State-Level.pdf.
[iv] "Beyond Financing: A Guide to Green Bank Design in the Southeast." Duke University Nicholas Institute for Environmental Policy Solutions, September 2018, https://nicholasinstitute.duke.edu/sites/default/files/publications/a-guide-to-green-bank-design-in-the-southeast-web.pdf.
[v] "Green Bank Techniques." Coalition for Green Capital, https://coalitionforgreencapital.com/what-is-a-green-bank/green-bank-techniques/.
[vi] "2021 U.S. Green Bank Annual Industry Report." American Green Bank Consortium, May 2021, https://greenbankconsortium.org/annual-industry-report.

[vii] "15.2-958.3:1. Local green banks." Virginia Legislative Information System, https://law.lis.virginia.gov/vacode/title15.2/chapter9/section15.2-958.3:1/.
[viii] Virginia Energy interview with staff at the Coalition for Green Capital, October 2021.
[ix] "Underwriting Efficiency: A Lender Handbook." Community Preservation Corporation, May 2017, https://communityp.com/wp-content/uploads/2017/05/CPC_Underwriting_Efficiency_Handbook_Full_Interactive_FINAL.pdf.
[x] As New York Green Bank has done: "NY Green Bank Issues RFP to Support Lenders Serving Disadvantaged Communities." NY Green Bank, September 2021, https://www.nyserda.ny.gov/About/Newsroom/2021-Announcements/2021-09-27-NY-Green-Bank-Support-Lenders_serving-Disadvantaged-Communities.
[xi] For example, CT Green Bank commissioned this report: "Mapping Household Energy & Transportation Affordability in Connecticut." VEIC, October 2020, https://www.veic.org/Media/Default/documents/resources/reports/Mapping-Household-Energy-and-Transportation-Affordability-Report-Oct-2020.pdf.
[xii] For example, the NYC Energy Efficiency Corporation has published in-depth case studies highlighting lessons learned from projects: https://nyceec.com/publications/.
[xiii] "Using Opportunity Zone Tax Benefits to Catalyze Green Projects in Distressed Communities." Natural Resources Defense Council, September 2019, https://greenbanknetwork.org/wp-content/uploads/2019/09/Opportunity-Zone-FS-19-09-D_02_locked.pdf.
[xiv] "Decarbonizing Homes: Improving Health in Low-Income Communities through Beneficial Electrification." RMI, October 2021, https://rmi.org/insight/decarbonizing-homes/.
[xv] "Heat Pump Systems." Efficiency Vermont, https://www.efficiencyvermont.com/products-technologies/heating-cooling-ventilation/heat-pumps.
[xvi] "Community Resiliency Hub in Petersburg." Virginia Environmental Justice Collaborative, March 2021, https://www.vaejc.com/post/community-resiliency-hub-in-petersburg.
[xvii] "Commonwealth of Virginia Energy Storage Study." Strategen, August 2019, https://static1.squarespace.com/static/5f8721831dd8c167b78e87b1/t/5ff10f3c143c0d28f21c25e4/1609633601749/Virginia%2BEnergy%2BStorage%2BStudy%2B-%2BFinal%2BReport%2B%2B2019.pdf.
[xviii] "Community Flood Preparedness Fund Grants and Loans." Virginia Department of Conservation and Recreation, https://www.dcr.virginia.gov/dam-safety-and-floodplains/dsfpm-cfpf.
[xix] "Smart-E Loan Program." Inclusive Prosperity Capital, https://www.inclusiveprosperitycapital.org/smart-e-loan/.
[xx] "Home Improvement Loans for an Energy-modern Home." Michigan Saves, https://michigansaves.org/residential-homes/.
[xxi] "Energy Storage Solutions." Connecticut Department of Energy and Environmental Protection, https://portal.ct.gov/pura/electric/office-of-utility-programs-and-initiatives/clean-energy-programs/energy-storage-solutions-program.
[xxii] "Storm Protection." Solar and Energy Loan Fund, https://solarenergyloanfund.org/loan/wind-resilience/.
[xxiii] "
Portfolio." NY Green Bank, https://greenbank.ny.gov/Investments/Portfolio.
[xxiv] "New Research on Virginia's Rental Housing Market." Virginia Realtors, February 2021, https://virginiarealtors.org/2021/03/15/new-research-on-virginias-rental-housing-market/.
[xxv] "Shared Solar Program." Dominion Energy, https://www.dominionenergy.com/virginia/renewable-energy-programs/shared-solar-program.
[xxvi] "Shared Solar Programs." Virginia State Corporation Commission, https://www.scc.virginia.gov/pages/Shared-Solar.
[xxvii] "Community Solar Project in Montgomery County Celebrated As It Breaks Ground." Montgomery County Green Bank, August 2021, https://mcgreenbank.org/paddington-square-news/.
[xxviii] "DC Green Bank and Flywheel Development Announce $3.2 Million Community Solar Installation." DC Green Bank, May 2021, https://dcgreenbank.com/press/dc-green-bank-and-flywheel-development-announce-3-2-million-community-solar-installation/.
[xxix] "About." Climate Access Fund, https://www.climateaccessfund.org/.

[xxx] "GEMS Financing Program." Hawaii Green Infrastructure Authority, https://gems.hawaii.gov/participate-now/for-homeowners/.
[xxxi] "§ 56-585.7. On-bill tariff program; electric cooperatives." Virginia Legislative Information System, https://law.lis.virginia.gov/vacode/title56/chapter23/section56-585.7/.
[xxxii] "On-bill Tariff Energy-Efficiency Program." Rappahannock Electric Cooperative, https://www.myrec.coop/bill-tariff-energy-efficiency-program.
[xxxiii] "Solar Futures Study." U.S. Department of Energy, September 2021, https://www.energy.gov/sites/default/files/2021-09/Solar percent20Futures percent20Study.pdf.
[xxxiv] "Save Energy." Dominion Energy, https://www.dominionenergy.com/virginia/save-energy.
[xxxv] "Programs for Your Home." Appalachian Power, https://takechargeva.com/programs/for-your-home.
[xxxvi] "Clean Energy Advisory Board." Virginia Department of Energy, https://energy.virginia.gov/renewable-energy/CEAB.shtml.
[xxxvii] "Smart-E Loan Program." Inclusive Prosperity Capital, https://www.inclusiveprosperitycapital.org/smart-e-loan/.
[xxxviii] "GEMS Financing Program." Hawaii Green Infrastructure Authority, https://gems.hawaii.gov/participate-now/for-homeowners/.
[xxxix] "Lending for Everyone." Solar and Energy Loan Fund, https://solarenergyloanfund.org/loan/the-self-loan/.
[xl] "EnergyPlus Home Improvement Payment Plan." National Energy Improvement Fund, https://www.neifund.org/energyplus-improvement-loan/.
[xli] "Residential Financing Options." New York State Energy Research and Development Authority, https://www.nyserda.ny.gov/All-Programs/Residential-Financing-Options.
[xlii] "Deferred Payment Loans for Energy Efficiency." Lawrence Berkeley National Laboratory, December 2021, https://eta-publications.lbl.gov/sites/default/files/oppco_case_study_12.22.21.pdf.
[xliii] "Multifamily Housing and Energy Efficiency: An Opportunity for Virginia to Lead." Virginia Multifamily Energy Efficiency Coalition, November 2017, https://vamfeec.org/wp-content/uploads/MFEEC-housing-report.pdf.
[xliv] The MassSave program, for example, offers roadmaps for incorporating energy efficiency measures into a refinancing event for affordable housing properties: https://leanmultifamily.org/resources/.
[xlv] "Multifamily Program." Dominion Energy, https://www.dominionenergy.com/virginia/save-energy/multifamily.
[xlvi] "Low Income Multifamily Program." Appalachian Power, https://takechargeva.com/programs/for-your-home/low-income-multifamily-program.
[xlvii] "Housing Innovations in Energy Efficiency (HIEE)." Virginia Department of Housing and Community Development, https://dhcd.virginia.gov/hiee.
[xlviii] "Multifamily Housing." Connecticut Green Bank, https://www.ctgreenbank.com/programs/multifamily/.
[xlix] "Affordable Housing Retrofit Accelerator." D.C. Sustainable Energy Utility, https://www.dcseu.com/retrofitaccelerator.
[l] "Multifamily Solar Loan." NYC Energy Efficiency Corporation, https://nyceec.com/products/#multifamilyLoan.
[li] "Solar for All 2020." DC Green Bank, https://dcgreenbank.com/project/flywheel-portfolio/.
[lii] "Takoma Overlook Condominiums." Montgomery County Green Bank, https://mcgreenbank.org/takoma-overlook-condominiums/.
[liii] Virginia Energy aims to make the statewide C-PACE program accessible to smaller projects. In the future, the C-PACE program could be situated under the CEFA, as it is under several existing green banks. More information about Virginia's statewide C-PACE program is at https://energy.virginia.gov/energy-efficiency/PACE.shtml.
[liv] "Commercial Loan for Energy Efficiency and Renewables (CLEER) Financing Program." Montgomery County Green Bank, https://mcgreenbank.org/cleer-financing/.
[lv] Per Virginia PPA law, no less than 50 kilowatts and no more than three megawatts shall be eligible for a third party power purchase agreement.
[lvi] "Commercial." Inclusive Prosperity Capital, https://www.inclusiveprosperitycapital.org/commercial/.
[lvii] "Home." Appalachian Solar Finance Fund, https://solarfinancefund.org/.

[lviii] A report from Community Climate Collaborative outlines additional recommendations, including building affordable housing near public transit and improving customer experience of existing bus service: "Transit Equity and Climate: Moving to a Cleaner Future." Community Climate Collaborative, September 2021, https://static1.squarespace.com/static/5a0c67f5f09ca475c85d7686/t/61660c5415f23c4de3a1019f/1634077793076/C3%27s+T%26E+-+Full+Report+-+Final+v04.pdf.
[lix] "Volkswagen Settlement Agreement." Virginia Department of Environmental Quality, https://www.deq.virginia.gov/get-involved/topics-of-interest/volkswagen-settlement-agreement.
[lx] "The Infrastructure Investment and Jobs Act will Deliver for Virginia." The White House, https://www.whitehouse.gov/wp-content/uploads/2021/08/VIRGINIA_Infrastructure-Investment-and-Jobs-Act-State-Fact-Sheet.pdf.
[lxi] "Green auto discount." Everence Federal Credit Union, https://doclib.everence.com/WorkArea/linkit.aspx?LinkIdentifier=id&ItemID=12111&libID=12077.
[lxii] "Diesel Emissions in Major US Cities Disproportionately Harm Communities of Color, New Studies Confirm." Inside Climate News, October 2021, https://insideclimatenews.org/news/27102021/diesel-pollution-environmental-justice/.
[lxiii] "Virginia Joins Agreement to Electrify Trucks and Buses." Electrification Coalition, December 2021, https://www.electrificationcoalition.org/virginia-joins-agreement-to-electrify-trucks-and-buses/.
[lxiv] Ibid at 65.
[lxv] "Electric School Buses." Dominion Energy, https://www.dominionenergy.com/our-stories/electric-school-buses.
[lxvi] "Appalachian Power funding electric school buses." The Roanoke Times, November 2021, https://roanoke.com/news/local/appalachian-power-funding-electric-school-buses/article_0aa73576-4722-11ec-97cf-9b0611e68437.html.
[lxvii] "Governor Northam Announces Grants to Replace 83 Diesel School Buses with Clean Alternatives." Office of the Governor of Virginia, August 2021, https://www.governor.virginia.gov/newsroom/all-releases/2021/august/headline-906644-en.html.
[lxviii] "Industry Leaders Rally around Pathways for Decarbonization." RMI, October 2021, https://rmi.org/industry-leaders-rally-around-pathways-for-decarbonization/.
[lxix] "Virginia Agriculture Facts & Figures." Virginia Department of Agriculture and Consumer Services, https://www.vdacs.virginia.gov/markets-and-finance-agriculture-facts-and-figures.shtml.
[lxx] "Energy Efficiency in Agriculture." Virginia Energy Efficiency Council, July 2017, https://vaeec.org/energy-efficiency-in-agriculture/.
[lxxi] "Webinar: Financing Biogas Projects." NY Green Bank, March 2020, https://greenbank.ny.gov/-/media/Project/Greenbank/files/Webinar-Financing-Biogas-Projects.ashx.
[lxxii] "The High Cost of Energy in Rural America: Household Energy Burdens and Opportunities for Energy Efficiency." American Council for an Energy-Efficient Economy, July 2018, https://www.aceee.org/research-report/u1806.
[lxxiii] "Unlocking the Transition: Politicians tout renewable energy jobs for ex-fossil fuel workers, but it's not so simple." Utility Dive, November 2021, https://www.utilitydive.com/news/unlocking-the-transition-politicians-tout-renewable-energy-jobs-for-ex-fos/609335/.
[lxxiv] "$500K grant will open solar project in Wise County." Bristol Herald Courier, July 2019, https://heraldcourier.com/news/500k-grant-will-open-solar-project-in-wise-county/article_77aa4d7c-4afd-5fb2-a93c-4e044ae4dcf8.html.
[lxxv] "9VAC15-60. Small Renewable Energy Projects (Solar) Permit by Rule." Virginia Register of Regulations, March 2021, http://register.dls.virginia.gov/details.aspx?id=9523.
[lxxvi] "Governor Northam and Congressman Griffith Announce Eight Southwest Virginia Economic Development Projects to Receive Pilot Grants." Office of the Governor of Virginia, September 2021, https://www.governor.virginia.gov/newsroom/all-releases/2021/september/headline-908996-en.html.
[lxxvii] "HB 1925 Virginia Brownfield and Coal Mine Renewable Energy Grant Fund and Program; established, report." Virginia Legislative Information System, https://lis.virginia.gov/cgi-bin/legp604.exe?212+sum+HB1925.
[lxxviii] "Brownfields Revolving Loan Fund." Rhode Island Infrastructure Bank, https://www.riib.org/brlf.

[lxxix] "Small Scale Wind." James Madison University Center for the Advancement of Sustainable Energy, https://www.jmu.edu/case/communities/small_scale_wind.shtml.
[lxxx] "Distributed Wind Assistance Program." James Madison University Center for the Advancement of Sustainable Energy, https://sites.lib.jmu.edu/case/?_ga=2.150840948.312035098.1641416289-1783504239.1640899416.
[lxxxi] "Virginia Counties by Population." Virginia-Demographics, https://www.virginia-demographics.com/counties_by_population.
[lxxxii] "Green 'liberty' bonds: The American way to win the war on climate change?" Canary Media, April 2021, https://www.canarymedia.com/articles/policy-regulation/green-liberty-bonds-point-to-a-possible-infrastructure-funding-solution.
[lxxxiii] "Virginia - State Energy Profile Overview." U.S. Energy Information Administration, https://www.eia.gov/state/?sid=VA#tabs-2.
[lxxxiv] Ibid.
[lxxxv] "Virginia Greenhouse Gas Inventory – 2018." Virginia Department of Environmental Quality, November 2021, https://www.deq.virginia.gov/home/showpublisheddocument/12633/637725680592630000.
[lxxxvi] "State Level Electric Energy Efficiency Potential Estimates." Electric Power Research Institute, May 2017, https://www.energy.gov/sites/prod/files/2017/05/f34/epri_state_level_electric_energy_efficiency_potential_estimates_0.pdf.
[lxxxvii] "State and Local Planning for Energy: Electricity Efficiency Economic Potential by Sector." National Renewable Energy Laboratory, https://maps.nrel.gov/slope/data-viewer?layer=energy-efficiency.economic-potential&res=state&year=2020&geoId=G51&filters=%5B%5D.
[lxxxviii] "Low-Income Energy Affordability Data (LEAD) Tool." U.S. Department of Energy, https://www.energy.gov/eere/slsc/maps/lead-tool.
[lxxxix] "QuickFacts: Virginia." U.S. Census Bureau, https://www.census.gov/quickfacts/VA.
[xc] "State and Local Planning for Energy: Single Family Home Electricity Savings Potential." National Renewable Energy Laboratory, https://maps.nrel.gov/slope/data-viewer?layer=resstock.single-family-home-electricity-savings-potential&res=state&year=2020&geoId=G51&filters=%5B%5D.
[xci] "State and Local Planning for Energy: Single Family Home Fuel Savings Potential." National Renewable Energy Laboratory, https://maps.nrel.gov/slope/data-viewer?layer=resstock.single-family-home-electricity-savings-potential&res=state&year=2020&geoId=G51&filters=%5B%5D.
[xcii] "Energy and Building Market Assessment Tool: C-PACE Application." U.S. Department of Energy, https://github.com/pnnl/CPACE.
[xciii] "Low-Income Energy Affordability Data (LEAD) Tool." U.S. Department of Energy, https://www.energy.gov/eere/slsc/maps/lead-tool.
[xciv] Low-Income Community Energy Solutions." U.S. Department of Energy, https://www.energy.gov/eere/slsc/low-income-community-energy-solutions.
[xcv] "2021 Annual Report." Clean Energy Advisory Board, January 2022, https://www.energy.virginia.gov/renewable-energy/documents/CEAB/Reports/CEAB_Annual_Report_2021_FINAL-TO-GA.pdf. "Appendix F: Market Research for Developing a LMI Solar Pilot Program in Virginia" of this report has detailed information on Virginia Income and Energy Burden Demographics.
[xcvi] Community Climate Collaborative conducted an analysis of energy burden in Charlottesville and its relationship to physical and demographic factors, including race: "Uncovering Energy Inequity." Community Climate Collaborative, July 2020, https://static1.squarespace.com/static/5a0c67f5f09ca475c85d7686/t/5f2071d39eb94c7ad741a90d/1595961851763/C3%27s+Uncovering+Energy+Inequity.pdf.
[xcvii] "How High Are Household Energy Burdens?" American Council for an Energy-Efficient Economy, September 2020, https://www.aceee.org/sites/default/files/pdfs/u2006.pdf.
[xcviii] "Low-Income Household Energy Burden Varies Among States — Efficiency Can Help In All of Them." U.S. Department of Energy, December 2018, https://www.energy.gov/sites/prod/files/2019/01/f58/WIP-Energy-Burden_final.pdf.