Feasibility Study for Commercial Sector "Solarize" Program

Prepared for the Richmond Region Energy Alliance

and VA SUN

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Executive Summary

This report evaluates the potential for a commercial sector "Solarize" program serving the Richmond, Virginia region. This study was conducted as part of an Urban and Regional Studies and Planning course at Virginia Commonwealth University entitled, *Sustainable Energy Planning & Policy* (URSP 645). Our team conducted this study on behalf of the Richmond Region Energy Alliance (RREA) and VA SUN, based on their shared interest in developing a commercial sector Solarize program in the Richmond region. The report provides a basic introduction to solar photovoltaic (PV) systems, summarizes the existing solar energy policy framework, reviews Solarize programs and other commercial sector solar deployment initiatives in Virginia and throughout the country, investigates local business owners' interest in investing in solar PV systems, and makes recommendations for the deployment of a commercial-sector Solarize program in the Richmond region.

The methodology for this report included a three-step process. The first step was an analysis of data from RREA's prior residential-sector SolarizeRVA program, US Census Bureau statistics, and GIS data from the City of Richmond, Henrico County, and Chesterfield County. Using this data, we analyzed the outcomes of the SolarizeRVA program and evaluated the potential for commercial-sector solar energy development in the region. The SolarizeRVA evaluation focused on key metrics such as total installed capacity and average cost per system. The GIS data was used to determine the total commercial building footprint areas within the region, which we then used to estimate total commercial sector solar energy potential. We also used GIS to cross-reference the SolarizeRVA results with US Census Bureau data to better comprehend the relationship (if any) between interest in solar and median household incomes.

For the second element of our research, we searched through government documents and mass media records to identify and evaluate three "case studies" of commercial-sector solar PV deployment programs in other cities. This process helped shed light on other Solarize ventures as well as other approaches to deploying solar PV in the commercial sector. Through this case study analysis we sought to identify best practices and strategies for local programs to encourage or facilitate commercial-sector solar PV use. Finally, we administered telephone interviews with Richmond region business owners to gauge their interest, or lack thereof, in solar PV investment. The specific approach to these telephone interviews is discussed in section 4.4.

Our findings indicate that the first phase of the SolarizeRVA program, focused on the residential sector, was an overall success. The program led to 20 signed contracts for over 107 kilowatts (kW) of new installed solar capacity at an average cost of $3.27/watt, far below the national average cost of around $4/watt. These results lead us to believe that a commercially focused SolarizeRVA program could also be a success. Our GIS analysis indicates the study region has over 174 million square feet of commercial-sector rooftop space, and installing solar photovoltaics (PV) on only 0.1% of that space would result in 2.75 megawatts (MW) of installed capacity and an average of nearly 3.4 million kilowatt hours (kWh) of electricity per year. This is enough to power over 250 homes, and the resulting 1663 metric tons of greenhouse gas (GHG) emissions savings would be equivalent to taking 560 cars off of the road.

Our three case studies examined three different approaches for deploying solar PV in the commercial sector: a Solarize program run by a neighborhood association in Minneapolis, a public sector initiative by the City of San Francisco, and a privately run bulk purchase model envisioned by the World Resources Institute. In all three case studies, the program organizers took a variety of steps to ease the decision-making process for potential commercial solar customers, such as by mapping the

target area and pre-screening potential buildings to identify prime locations for solar power systems, and by establishing a variety of financing options for the local business owners to consider.

Our interviews indicate that there exists a major opportunity to market SolarizeRVA to businesses. Most, if not all, of the business owners we spoke to were not familiar with SolarizeRVA, and therefore RREA and VA SUN would need to engage business owners through public relations, marketing, and other grass-roots efforts to raise interest in the program. The Solarize Kingfield case study in Minneapolis provides good example of public outreach approaches. The interviews also identified several concerns to be addressed in organizing a commercial-sector Solarize program. For example, very small businesses are often managed by owner-operators who are extremely busy with day-to-day operations and have little time for bigger picture, longer-term questions like whether or not to invest in solar PV. In addition, many small businesses do not own the buildings in which they are located. On the other hand, with larger businesses, the owners may not be involved on a day-to-day basis and can sometimes be difficult to contact. In some cases, the owners are larger corporate entities that are even more difficult to contact and negotiate with. We conclude that small to mid-sized businesses, most likely in the 50–100 employee and 20–50 million dollar revenue per year range, would be the best focus for further outreach.

The interviews also revealed that cost effectiveness is, by far, the largest obstacle to PV investment among local business owners. Most business owners who were familiar with solar expressed a need for a return on investment of five years or less. Therefore, it is important for RREA and VA SUN to educate business owners, as part of their outreach process, about the cost-savings associated with buying PV via a bulk-purchase or Solarize program, and the various financial incentives available to Richmond region businesses that invest in solar energy.

We also conclude that there is an overall lack of knowledge and energy literacy among Richmond region businesses. Most business owners contacted were not well educated on what proportion of their company's overhead was from electricity or other energy use. Similarly, few knew if this amount seemed to fluctuate seasonally, or if it was fairly consistent year round. Therefore, moving forward, RREA and VA SUN should continue to increase business owners' energy literacy, and help them be more cognizant of how such costs affect their business, particularly considering recent rising energy costs in the Dominion Virginia Power territory.

1. Introduction to Solar Energy Systems

Though oil and gas continue to dominate today's industrialized world, their standing is already beginning to decline.[1] New sources of oil in North America, for example, are becoming progressively difficult to find and extract because of cost, environmental risk, and a lack of feasibility/technology.[2] This, coupled with the overall rising cost of energy, has led to a greater emphasis on energy conservation and the pursuit of alternative sources such as biomass, wind, and solar photovoltaic (PV) systems. Within this realm, solar PV systems are the most practical way for businesses and homeowners alike to provide clean, renewable electricity to a building.

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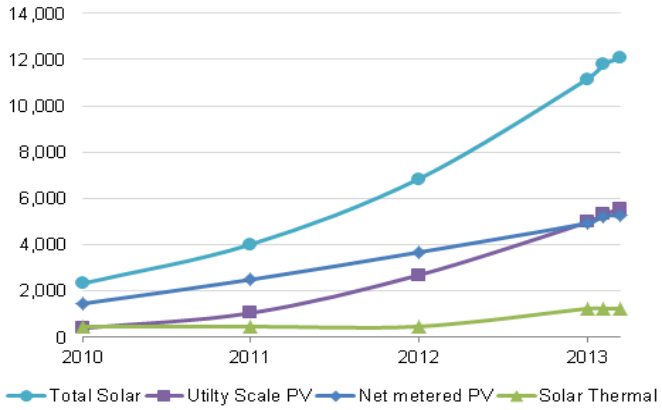
[1] Burkett, V. (2011). Global climate change implications for coastal and offshore oil and gas development. *Energy Policy*, *39*(12), 7719–7725.

[2] Mares, M., & Larys, M. (2012). Oil and natural gas in Russia's eastern energy strategy: Dream or reality? *Energy Policy*, *50*, 436–448.

1.1 Trends and Implications

Reports indicate that solar PV deployment in the United States (US) has been increasing significantly in recent years. This is particularly true for commercial and residential PV systems, also known as distributed PV (DPV), a term that distinguishes these systems from larger "utility-scale" PV. Since 2010, US solar capacity has increased 418%, with over half of this increase from DPV. Net-metered DPV now totals 5,251 megawatts (MW) of total installed capacity.[3]

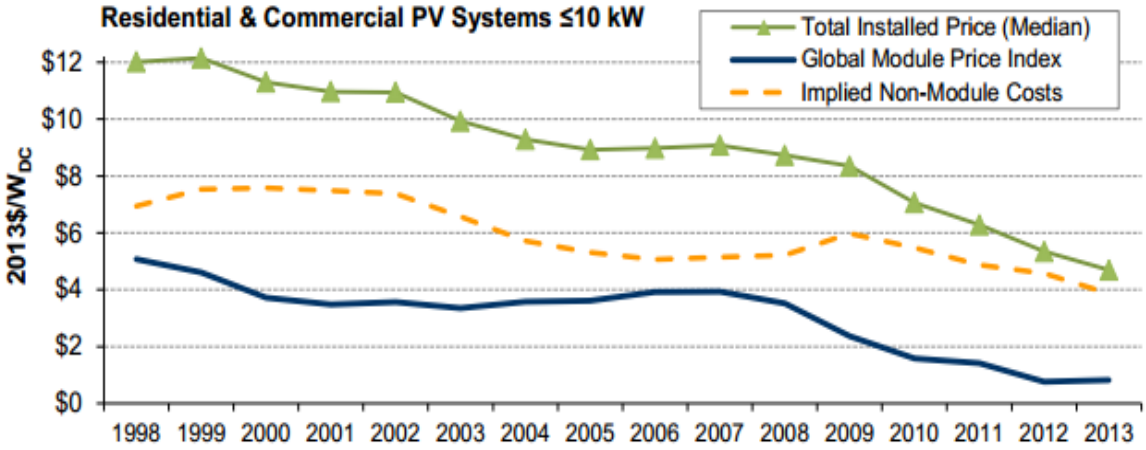
Figure 1. United States Solar Capacity (MW), 2010-2014



Source: US Energy Information Administration, 2014

In conjunction with various public policy incentives that have encouraged DPV deployment, there has been a recent, drastic decrease in the costs of materials and installation. The installed price of solar PV systems has reduced dramatically over the past 15 years, including a 50% drop (from an average of almost $8/watt to about $4/watt) from 2009-2013, as shown in Figure 2. A recent Lawrence Berkeley National Laboratory report indicates that installation prices are "falling year-over-year by 12 to 15% depending on system size."[4]

Figure 2. Price Trend for DPV Systems, 1998–2013



Source: Barbose et al., 2014

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[3] US Energy Information Administration. (2014). *Electricity sales, revenue, and average price*. Retrieved from: http://www.eia.gov/electricity/sales_revenue_price/.

[4] Barbose, G., Weaver, S., & Darghouth, N. Lawrence Berkeley National Laboratory, (2014). *Tracking the sun vii: An historical summary of the installed price of photovoltaics in the United States from 1998 to 2013*. Retrieved from: emp.lbl.gov/sites/all/files/lbnl-6808e_0.pdf. p. 1.

Ultimately, these trends indicate an increasing movement of homeowners and businesses investing in solar PV. Installed capacity has risen significantly over recent years, as module costs have decreased and municipalities and installers have become more familiar with the technology. Furthermore, with continual advances in technology and storage, solar PV systems are making more and more economic sense for interested investors. It is possible that this growing trend could significantly reshape the nature of the energy industry in the US in coming years.

1.2 Public Policy Framework for Solar PV

At the federal level, one of the main enticements for solar investors is the federal Investment Tax Credit (ITC). This is equal to 30% of expenditures, with no maximum limit to the credit amount. Authorized "solar energy property includes equipment that uses solar energy to generate electricity, to heat or cool (or provide hot water for use in) a structure, or to provide solar process heat."[5] However, the ITC will step down to 10% of expenditures for commercial applications starting in 2017, while residential credits will expire on that date.[6]

US states also have several policies to encourage DPV, though these are far from uniform. For instance, numerous states have net metering laws, financial incentives, and RPS', the details of which vary greatly. Several US states have established tax credits similar to the federal ITC (often called personal tax credits) that can be coupled with the ITC to further encourage solar energy. The state of Virginia does not have such tax credits, or any other major policy to encourage solar (e.g., an RPS).

Local initiatives also play a role in encouraging DPV investment, though these are even more diverse than federal or state incentives. For example, localities can offer property tax exemptions or abatements for residents or businesses who invest in solar energy. Low or zero-interest loans, grants, and rebates for solar energy projects are also common, contingent upon budgetary restraints. Localities can also encourage solar via the removal of building code or zoning barriers, streamlining permitting procedures and reducing permitting and inspection fees, or by offering valuable technical assistance toward project planning and financing.

1.3 Challenges to Solar PV Deployment

Despite the recent shift toward solar energy use in the US, several challenges remain. For instance, research suggests that while "hard" or module costs (e.g., costs of the panels themselves) have fallen in recent years, the remaining non-module or "soft" costs have remained relatively fixed.[7] These soft costs include local permitting fees, installer profit, overhead, taxes, and contracting fees.[8] Solar PV systems may also face regulatory, legal, or legislative challenges, such as utility commission regulations that hinder innovative financing structures. Other key threats include high up-front costs, variability in output, and siting issues (e.g., shading, roof orientation, etc.).

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[5] Virginia Department of Environmental Quality. (2014). *Incentives for Virginians*. Retrieved from: http://www.deq.virginia.gov/Programs/PollutionPrevention/VirginiaInformationSourceForEnergy/FinancialIncentives.aspx.

[6] Baca, J. Solar Energy Industries Association, (2014). *Solar deployment and policy*. Retrieved from: http://www.eia.gov/conference/2014/pdf/presentations/baca.pdf.

[7] See: Stanfield, S., Schroeder, E., & Culley, T. Interstate Renewable Energy Council, Inc., (2012). *Sharing success: Emerging approaches to efficient rooftop solar permitting.* Retrieved from: http://www.irecusa.org/wp-content/uploads/FINAL-Sharing-Success-w-cover-revised-final052012.pdf.

[8] Ardani, K., Barbose, G., Margolis, R., Wiser, R., Feldman, D., & Ong, S. US Department of Energy, National Renewable Energy Laboratory / Lawrence Berkeley National Laboratory, (2012). *Benchmarking non-hardware balance of system (soft) costs for U.S. photovoltaic systems using a data-driven analysis from PV installer survey results* (DOE/GO-10212-3834). Retrieved from: http://www.nrel.gov/docs/fy13osti/56806.pdf.

1.4 Current PV Capacity Figures for Virginia

As of June 2014, the state of Virginia had 11.55 total MW of net-metered DPV capacity,[9] enough to power well over 1,000 homes. However, this capacity is far less than the nearby state of Maryland, for instance, which has 92 MW of net-metered DPV capacity.[10] This gap is due in no small part to the differences in the states' policies towards solar energy. For example, Maryland has a Renewable Portfolio Standard (RPS) that forces utility companies to deliver a certain proportion of its power from renewable sources. Maryland also offers state tax credits for DPV investment. Virginia has neither an RPS nor a state tax credit for solar. However, Virginia does have strong solar potential, due to its availability of sun resources and relatively strong economic base. The next section of our report discusses national, state, and local policies to encourage DPV, as well as specific financial incentives to the Greater Richmond, Virginia area.

2. Financial Incentives and Financing Options for Solar PV in the Richmond Region

Businesses and homeowners in the Richmond area can utilize a number of financial incentives with regard to solar PV systems. Below, they are broken down by state initiatives versus those offered by Dominion Virginia Power (henceforth referred to as "Dominion"), the large, investor-owned utility that services the greater Richmond region. While some cities in other states have specific local incentives for DPV, the City of Richmond does not.

2.1 State Incentives

A variety of small financial incentives are available at the state level. In addition to those listed below, a bill passed in 2014 (SB 18), prevents localities from applying "machinery and tools" taxes to solar energy equipment.

2.1.1 Net Metering

This is a direct kilowatt hour (kWh)-for-kWh offset on a commercial or residential utility bill for all energy produced, credited over 12-month period. Virginia has a capacity limit of 500 kW for commercial and 20 kW for residential systems, with a limit on overall enrollment cap of 1% of a utility's peak capacity.[11] In 2011, however, the Virginia General Assembly adopted House Bill (HB) 1983, which enabled Virginia utilities to pursue stand-by charges, and later that year, the State Corporation Commission (SCC) approved Dominion's request for a $4.19/kW monthly stand-by charge for owners of net-metered systems larger than 10 kW.[12] Appalachian Power Company (APCo), Virginia's second largest electric utility provider behind Dominion, also recently received SCC approval for a similar stand-by charge.[13]

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[9] State Corporation Commission. (2014b). *Net metering installations, June 30, 2014.* Retrieved from https://www.scc.virginia.gov/scc-internet/pue/index.aspx.

[10] Maryland Energy Administration. (2014). *Solar energy progress.* Retrieved from: http://energy.maryland.gov/solar.html.

[11] Database of State Incentives for Renewables and Efficiency (DSIRE). (2014c). *Virginia: Net metering*. Retrieved from: http://dsireusa.org/incentives/incentive.cfm?Incentive_Code=VA02R.

[12] Shapiro, C. (2011, November 24). Dominion to charge fee to heavy users of solar power. *The Virginian-Pilot*. Retrieved from: http://hamptonroads.com/2011/11/dominion-charge-fee-heavy-users-solar-power.

[13] State Corporation Commission. (2014a). *Case Summary for Case Number: PUE-2014-00026.* Retrieved from: http://www.scc.virginia.gov/newsrel/e_apcobi_14.aspx.

2.1.2 Solar Renewable Energy Certificates (SRECs)

Owners of commercial or residential solar PV systems in RPS states can sell SRECs to their utilities, helping to recoup installation costs and aiding in financing. The lack of a true RPS in Virginia[14] means SRECs are not sold to Virginia utilities (i.e., Virginia utilities do not need renewables to meet RPS goals.) However, SRECs generated in Virginia can be sold to utilities in other states (currently, only in Pennsylvania). The value of SRECs in the Pennsylvania market varies greatly, making them an unreliable, but potentially valuable, means of offsetting the costs of PV systems.

2.1.3 Small Business & Non-Profit Loan Program

In April of 2014, HB 864 mandated that the Virginia Small Business Financing Authority provide financing for wind and solar projects to small businesses and nonprofits.[15]

2.1.4 Clean Energy Manufacturing Incentive Grant Program

This grant program, created in 2011, is available to commercial clean energy manufacturers for up to six years if they: 1) begin or expand its operations in Virginia on or after July 1, 2011; 2) make a capital investment of more than $50 million in Virginia on or after July 1, 2011; 3) create 200 or more new full-time jobs on or after July 1, 2011; 4) enter a memorandum of understanding setting forth the requirements for capital investment and the creation of new full-time jobs.[16]

2.1.5 Historic Property Tax Credits

Since the Richmond region has several historical properties, we looked into whether installation of PV panels on historic properties would qualify for historic property tax credits. We spoke with Ms. Elizabeth Tune with the Virginia Department of Historic Resources, who informed us that solar panels would be eligible for the rehabilitation tax credit, as they are considered part of the HVAC system. Rehabilitation tax credits are:

> Dollar-for-dollar reductions in income tax liability for taxpayers who rehabilitate historic buildings. Credits are available from both the federal government and the State of Virginia. The amount of the credit is based on total rehabilitation costs. The federal credit is 20% of eligible rehabilitation expenses. The state credit is 25% of eligible rehabilitation expenses. In some cases, taxpayers can qualify under both programs, allowing them to claim credits of 45% of their eligible rehabilitation expenses.[17]

According to Ms. Tune, plans for these would need to be reviewed on a case by case basis to ensure they follow the historic building standards. She claimed that it would be important that the PV panels not be visible. If they were visible, they must be located in a 'very secondary' location; they

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[14] Database of State Incentives for Renewables and Efficiency (DSIRE). (2014d). *Virginia: Voluntary renewable energy portfolio goal* . Retrieved from: http://www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=VA10R.

[15] Virginia's Legislative Information System. (2014). *Hb 864 Virginia small business financing authority; definition of eligible business & business enterprise*. Retrieved from: http://lis.virginia.gov/cgi-bin/legp604.exe?141 sum HB0864.

[16] Database of State Incentives for Renewables and Efficiency (DSIRE). (2014a). *Virginia: Clean energy manufacturing incentive grant program*. Retrieved from: http://www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=VA46F.

[17] Virginia Department of Historic Properties. (2013). *Rehabilitation tax credits: Frequently asked questions*. Retrieved from: http://www.dhr.virginia.gov/tax_credits/tax_credit_faq.htm#A.

cannot be located on the primary façade or elevation, nor can they change the historic character of the building or its property.

2.2 Dominion Virginia Power Incentives

Dominion has recently unveiled a few solar PV pilot programs that are available to business owners, though it is currently uncertain how many firms have stepped forward to use these incentives.

2.2.1 Solar Purchase Program

This is a buy-all, sell-all deal for up to 3 MW of customer-owned solar, available to eligible commercial and residential customers for an initial five-year period. This pilot program allows owners of small solar systems on homes and businesses to sell the power and the associated RECs to Dominion at 15 cents/kWh, while buying regular grid power at retail prices for their own use. Participating customers purchase all of the electricity for their home or business from the company on their current rate schedule.[18]

2.2.2 Renewable Generation Tariff

This pilot program allows commercial customers to buy larger amounts of renewable power from providers, with the utility acting as a go-between and collecting a monthly administrative fee. Customers specify a type of green electricity and then negotiate a contract with Dominion, which signs a power purchase agreement with the operator of the renewables project. The customer's purchase would be "self-funding;" any costs associated with delivering the renewable energy would be passed on to them. That includes a monthly administrative fee of $500 per participating electricity buyer.[19]

2.2.3 Third Party Power Purchase Agreement (PPA) Program

This two-year pilot program took effect on July 1, 2013, allowing commercial Dominion customers to install projects as large as 1 MW using PPAs financed by private companies. Projects must have a minimum size of 50 kW, so the program can be used by commercial customers but excludes homeowners, whose solar PV systems often range from 4–8 kW (note: the 50 kW minimum does not apply to tax-exempt entities).[20]

2.2.4 Community Solar Partners Program

This multi-year pilot program aims to expand community-based solar energy, with Dominion installing, owning, and operating "up to 30 megawatts of company-owned solar facilities on leased rooftops or on the grounds of commercial businesses and public properties throughout [their] Virginia service area."[21] Large commercial projects have already been planned in proximity to existing

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[18] Database of State Incentives for Renewables and Efficiency (DSIRE). (2014b). *Virginia: Dominion Virginia power - solar purchase program.* Retrieved from: http://www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=VA58F.

[19] Davidson, R. (2013, July 01). *Case study - Dominion Virginia Power prepares to launch green tariff.* Retrieved from: http://www.windpowermonthly.com/article/1187596/case-study---dominion-virginia-power-prepares-launch-green-tariff.

[20] State Corporation Commission. (2013). *Renewable energy pilot program*. Retrieved from: https://www.scc.virginia.gov/pue/pilot.aspx.

[21] Dominion Virginia Power. (2014). *Solar partnership program.* Retrieved from: https://www.dom.com/business/dominion-virginia-power/ways-to-save/renewable-energy-programs/solar-partnership-program.

Dominion infrastructure at Capital One and Virginia Union University in the Richmond region, and the Prologis Concorde Distribution Center in Sterling, Virginia.

Table 1. Summary of Financial Incentives

Incentive	Applicable Sectors
Small Business & Non-Profit Loan Program	Commercial Only
Clean Energy Manufacturing Incentive Grant Program	Commercial Only
Renewable Generation Tariff	Commercial Only
Dominion Third Party Power Purchase Agreement (PPA) Program	Commercial Only
Dominion Community Solar Partners Program	Commercial Only
Net Metering	Commercial and Residential
SRECs	Commercial and Residential
Dominion Solar Purchase Program	Commercial and Residential

3. Overview of Solarize Programs

As a means to alleviate some of the obstacles to DPV installations, a recent national trend has been the establishment of community or neighborhood based "Solarize" programs. Since 2009, Solarize programs have been developing throughout the US as a group-oriented purchasing approach that is often sponsored or organized by community groups, regional energy organizations, or a locality itself. These programs aim to help persons overcome the logistical cost hurdles by facilitating purchases and contractors. For instance, hard costs of solar systems can be reduced via bulk module purchasing, while soft costs are often streamlined through permitting and marketing (i.e., reduced customer acquisition costs for contractors).

3.1 History of Programs Throughout the Country

The first Solarize program was developed in Portland, Oregon in 2009 as a means to reduce the costs of DPV installations though a short-term deployment effort in the community. These grassroots-driven programs have helped accelerate DPV growth in the US, particularly by overcoming market barriers such as high up-front costs and overall intricacy of solar purchasing decisions. Additionally, by presenting Solarize as limited-time programs, consumers are often more inspired to act. Such campaigns also heighten consumer awareness, education, and decision-making processes via community partnerships within the local market.[22]

Ultimately, the Solarize model, via community activism and high-volume group purchasing, has increased access to solar energy. It has been estimated that the city of Portland has added over 1.7 MW of DPV after only three years of Solarize campaigns.[23] This innovative model has prompted the installation of approximately 1,960 solar PV systems in the US from 2009–2012,[24] with several more Solarize-related installations occurring regularly.

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[22] Irvine, L., Sawyer, A., & Grove, J. U.S. Department of Energy, National Renewable Energy Laboratory. (2012). *The solarize guidebook: A community guide to collective purchasing of residential pv systems* (DOE/GO-102012-3578). Retrieved from: http://www.nrel.gov/docs/fy12osti/54738.pdf.

[23] Ibid.

[24] International City/County Management Association. (2012). *Solar communities*. Retrieved from: http://webapps.icma.org/pm/9410/public/solar.cfm?title=SolarCommunities&subtitle=&author=.

3.2 Solarize Programs in Virginia

In the year 2014, seven different Solarize programs were initiated in Virginia, by RREA, VA Sun, and two other related organizations: Community Housing Partners (CHP) and the Local Energy Alliance Program (LEAP), and the Richmond Region Energy Alliance (RREA). Table 2 summarizes the number of customer leads (i.e., interested local individuals as identified by online sign-up forms) generated by each program as of the end of 2014.

Table 2. Solarize Programs in Virginia

Program Name	Program Sponsor	Leads
Solarize Charlottesville	LEAP	750+
Solarize Blacksburg	CHP	464
Solarize Roanoke	CHP	350
SolarizeRVA	RREA	240
Solarize Harrisonburg	VA SUN	200
Solarize Floyd County	VA SUN	90
Solarize NOVA	LEAP	Accepting forms
Arlington Solar Co-op	VA SUN	In initial stages

The Solarize Charlottesville program generated the most customer interest, despite being located in a much smaller city than Richmond. Blacksburg, an even smaller town, generated the second most customer interest. This suggests that the communities of Charlottesville and Blacksburg may have greater environmental sensitivity and the other characteristics of conventional solar energy customers, possibly due to their status as educated university towns. The Solarize NOVA (Northern Virginia, focused on interested residents of Leesburg and Loudoun County) program is still, at the time of this writing, accepting interest forms from residents. It should be noted that all of the current Virginia Solarize programs have been focused on residential solar, and not commercial.

3.3 Review of Literature

Several authors have outlined how community-based Solarize programs can work to provide financial benefits and mitigate concerns about climate change and rising energy costs,[25] as well as allowing for the achievement of solar economies of scale.[26] Solarize programs can also contribute to collaborative emissions reductions goals as well as overall community cohesion.[27] In fact, communal collaboration and unity are often cited as key to bringing civic members together for a common goal.[28,29,30] Often, education and cooperation associated with Solarize programs is established by way

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[25] Bomberg, E., & McEwen, N. (2012). Mobilizing community energy. *Energy Policy*, *51*, 435–444.

[26] Coughlin, J., Grove, J., Irvine, L., Jacobs, J. F., Phillips, S. J., Sawyer, A., & Weidman, J. U.S. Department of Energy, SunShot, (2012). *A guide to community shared solar: Utility, private, and nonprofit project development* (DOE/GO-102012-3569). Retrieved from: http://www.nrel.gov/docs/fy12osti/54570.pdf.

[27] Hoffman, S. M., & High-Pippert, A. (2010). From private lives to collective action: Recruitment and participation incentives for a community energy program. *Energy Policy*, *38*(12), 7567–7574.

[28] Austin Energy, KEMA Inc. (2012). *Best-practices basis for an Austin energy community solar choice program: A preliminary review for discussion.* Retrieved from: https://austinenergy.com/wps/wcm/connect/06de3671-52a5-409a-8edb-68a49f1fbd74/2012bestPracticeBasisforAECommunitySolarChoiceProgram.pdf?MOD=AJPERES.

[29] Bollinger, B., & Gillingham, K. (2012). *Peer effects in the diffusion of solar photovoltaic panels.* Retrieved from: http://www.yale.edu/gillingham/BollingerGillingham_PeerEffectsSolar.pdf.

of social interactions.[31] Aylett conducted a case study of Solarize Portland to investigate the role of public participation and interaction, concluding that Solarize efforts have the capacity to achieve significant sustainability goals by coordinating key partnerships within communities.[32]

4. Findings

4.1 Commercial Rooftop Space in Richmond Region

Knowledge of the technical potential for DPV systems is essential for understanding the market potential. We first sought to estimate the total amount of commercial rooftop space from the building footprints of the three core jurisdictions in the RREA coverage area (Henrico County, Chesterfield County, and the City of Richmond). Each jurisdiction supplied GIS land use data at the parcel level, as well as shapefiles containing all buildings within their respective boundaries. We assumed that the use of each building matched the designated use of the parcel it was located on, and commercial buildings were defined as those located on parcels with industrial, office, retail, or mixed uses.

We used a rule of thumb ratio of 75% to convert building footprint area to available rooftop area, based on an assumption that most commercial buildings have flat roofs and can accommodate PV on the majority of that rooftop space. However, determining the amount of rooftop space *suitable* for DPV was outside the scope of this study, and we were not able to account for shading, poor structural condition, and other factors that would limit the ability to install PV or the effectiveness of an installed PV system. Instead, the values represent a general estimate of the total amount of commercial rooftop space in the core jurisdictions. Table 3 describes the findings of the GIS analysis.

Table 3. Commercial Building Footprint Area per Jurisdiction

Jurisdiction	Footprint Area (ft^2)	Rooftop Area (ft^2)
Chesterfield County	80,193,840	60,145,380
Richmond City	61,523,385	46,142,539
Henrico County	90,455,627	67,841,720
Total	*232,172,852*	*174,129,639*

Using the standard 17% efficiency rating of solar PV systems, the available rooftop space can be used to estimate total potential PV capacity, using the following formula:

Potential Capacity:

$$174 \times 10^6 ft^2 \times \frac{m^2}{10.76 ft^2} = 16.3 \times 10^6 m^2 \times \frac{1kW}{m^2} \times 0.17 = 2.77 \times 10^6\ kW$$

Based on this formula, and the estimated available rooftop area of more than 174 million square feet, commercial buildings in the Richmond region have the potential to install as much as 2.8 million kW, or 2,800 MW, of solar PV capacity.

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[30] Bomberg, E., & McEwen, N. (2012). Mobilizing community energy.

[31] Irvine, L., Sawyer, A., & Grove, J. U.S. Department of Energy, National Renewable Energy Laboratory. (2012). *The solarize guidebook: A community guide to collective purchasing of residential pv systems*.

[32] Aylett, A. (2013). Networked urban climate governance: neighborhood-scale residential solar energy systems and the example of solarize Portland. *Environment and Planning C: Government and Policy*, *31*, 858–875.

Given 4.5 hours of solar insolation (i.e., incident solar radiation) in the Richmond region, and a standard de-rating factor of 0.75, the total energy these systems could produce is calculated as follows:

Energy Produced:

$$2.77 \times 10^6\ kW \times 0.75 \times \frac{4.5hr}{day} \times \frac{365\ day}{yr} = 3.4 \times 10^9 \frac{kWh}{yr}$$

One of the primary societal benefits of solar PV is the reduction of carbon dioxide (CO_2) and other greenhouse gas (GHG) emissions. According to the most recent data available from the US Environmental Protection Agency, electricity production in the Richmond area (i.e., the SERC Virginia/Carolina grid sub-region) emits 1079.57 lbs. of CO_2-equivalent GHGs per MWh of electricity produced.[33] Using this number, potential carbon reduction from commercial-sector solar PV in the region totals approximately 3.66 billion lbs, or 1.66 million metric tons (MMT), calculated as follows:

CO_2 Reductions:

$$3.4 \times 10^9 kWh \times \frac{1079.57\ lbs\ GHGs}{MWh} \times \frac{MWh}{1000\ kWh} = 3.66 \times 10^9\ lbs\ GHGs$$

Below, Table 4 offers different scenarios for certain levels of solar PV installations. However, it should be noted that these percentages are ambitious, particularly considering that installing 1% of commercial rooftop space with DPV would amount to a MW capacity figure that is more than twice the current installed DPV capacity of the entire state of Virginia. Installing 1% of commercial rooftop space with DPV would equivalently power more than 2,500 homes. Yet, a more feasible goal of just 0.1% of rooftop space with DPV would be equivalent to powering 253 homes or taking 560 vehicles off of the road.[34] 0.25% of rooftop space in the Richmond region with DPV would increase these figures to 632 homes or 1,400 vehicles taken off of the road. These figures were calculated based on estimates from the US Energy Information Administration, which shows that the average household in Virginia consumes 1,117 kWh monthly,[35] translating to an annual energy use of 13,404 kWh. Table 4 details these different scenarios for PV installations, ranging from 0.1% to 1%.

Table 4. Installation Scenarios

% Rooftop Installation	Installed Capacity (MW)	Energy Produced (kWh/year)	Equivalent Number of Homes Powered	CO_2 –Equiv GHG Savings (lbs.)	CO_2 –Equiv GHG Savings (metric tons)	Equivalent Vehicles Taken off the Road
0.10%	2.75	3,389,035	253	3,658,700	1,663	560
0.25%	6.88	8,472,586	632	9,146,750	4,158	1,400
0.50%	13.76	16,945,143	1,264	18,293,500	8,315	2,800
1.00%	27.51	33,890,345	2,528	36,587,000	16,630	5,600

[33] US Environmental Protection Agency. (2012). *'eGRID 9th edition version 1.0 subregion file* (Year 2010 Data). Retrieved from: http://www.epa.gov/cleanenergy/energy-resources/egrid/.

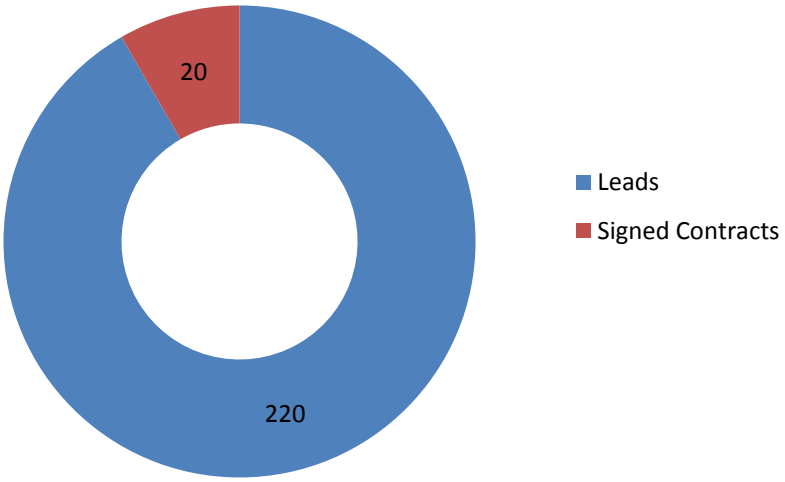
[34] This calculation is based on an assumed average of 10,000 miles per year per vehicle, 30 mpg fuel efficiency, and a 19.6 lbs./gal carbon coefficient, producing an annual total of 6,533.33 lbs. per vehicle.

[35] US Energy Information Administration. (2009). *Household energy use in Virginia*. Retrieved from: http://www.eia.gov/consumption/residential/reports/2009/state_briefs/pdf/VA.pdf.

4.2 SolarizeRVA Program

The SolarizeRVA program was launched in the spring of 2014[36] to encourage and facilitate residential DPV investments. Area residents, non-profit organizations, and local businesses collaborated on the program, helping to educate homeowners about the logistics of going solar. The program was organized by the RREA, who contracted with two area solar installation firms for design and installation efforts, Altenergy and Integrated Power Sources of Virginia.[37] The SolarizeRVA program consisted of six solar energy and energy efficiency community workshops, which were well attended by area residents. Ultimately, as Figure 3 indicates, 240 individuals expressed further interest in investing in PV on their homes, from which 20 contracts were eventually signed.

Figure 3. SolarizeRVA Leads vs. Signed Contracts



The 20 signed contracts from the SolarizeRVA program totaled over 100 kW of installed capacity and over $350,000 of total solar investment in the Richmond region. The average power capacity per system was roughly 5.4 kW.[38] The advertised price was $3.45 per watt for 3 kW to 5 kW systems, and $3.35 per watt for systems 5 kW or larger, but data provided by RREA indicates an actual average cost of only $3.27 per watt.[39] All of these prices are well below the current national average of roughly $4.00 per watt.[40] Table 5 displays some key statistics from the SolarizeRVA program.

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[36] Warnick, J. (2014, May 02). *Discounted solar power installation*. Retrieved from: http://www.nbc12.com/story/25417034/discounted-solar-power-instalation.

[37] Richmond Region Energy Alliance (2014). *Solarizerva: Installers*. Retrieved from: http://www.solarizerva.org/installers/.

[38] Author calculation. Installed DPV capacity / Signed Contracts = 5.355 kW Capacity per System.

[39] Based on author calculations. Estimated Total Solar Investment / Installed DPV Capacity = Cost per kW of $3,273.02. Divide by 1000 to convert to watts, and Cost per Watt = $3.27.

[40] Marsh, A. (2014, March 06). *Breaking down the cost of solar*. Retrieved from: http://www.solar-states.com/breaking-down-the-cost-of-solar/.

Table 5. SolarizeRVA Key Statistics

Variable	Figure
Customer Leads	240
Signed Contracts	20
Installed DPV Capacity	107.1 kW
Estimated Total Solar Investment	$350,540
Cost per System	$17,527
Capacity per System	5.355 kW
Cost per kW	$3,273.02
Cost per Watt	$3.27

If all of the signed contracts from the SolarizeRVA program are actually installed, Virginia's total installed DPV capacity would raise by roughly 0.9%. While this may not seem like a great deal, it should be noted that this percentage was generated over a very short time frame, with only 20 signed contracts for installations (note: a signed contract does not necessarily imply that it will be built). In other words, the increasing use of Solarize programs throughout Virginia is significantly expanding opportunities for homeowners interested in solar energy systems, and increasing the state's total installed DPV capacity at a higher rate than would be felt without Solarize initiatives.

We then conducted a GIS analysis of the SolarizeRVA program results, to evaluate which parts of the region demonstrated the most interest in solar. We created a map that displays the customer leads and signed contracts within the RREA service boundaries. We then overlaid this data with household income at the census tract level to determine if there is a relationship between income and interest in solar power (Figure 4). The results suggest that most leads and contracts did, in fact, occur in higher-income areas, often in the west end of Henrico and Chesterfield Counties, as well as Goochland County. Richmond city, however, did possess a fair share of signed PV contracts.

A more zoomed in figure (Figure 5) also illustrates that several of the signed contracts were concentrated in high-income areas of Chesterfield, Goochland, and Henrico counties. Most of the contracts within the Richmond city limits were also in higher income areas, although there were two in lower or medium-income areas of the Northside. This suggests that the current market for residential DPV in the SolarizeRVA program boundaries is concentrated predominantly in areas with median household incomes greater than $50,000.

Figure 4. SolarizeRVA Leads and Installations by Income

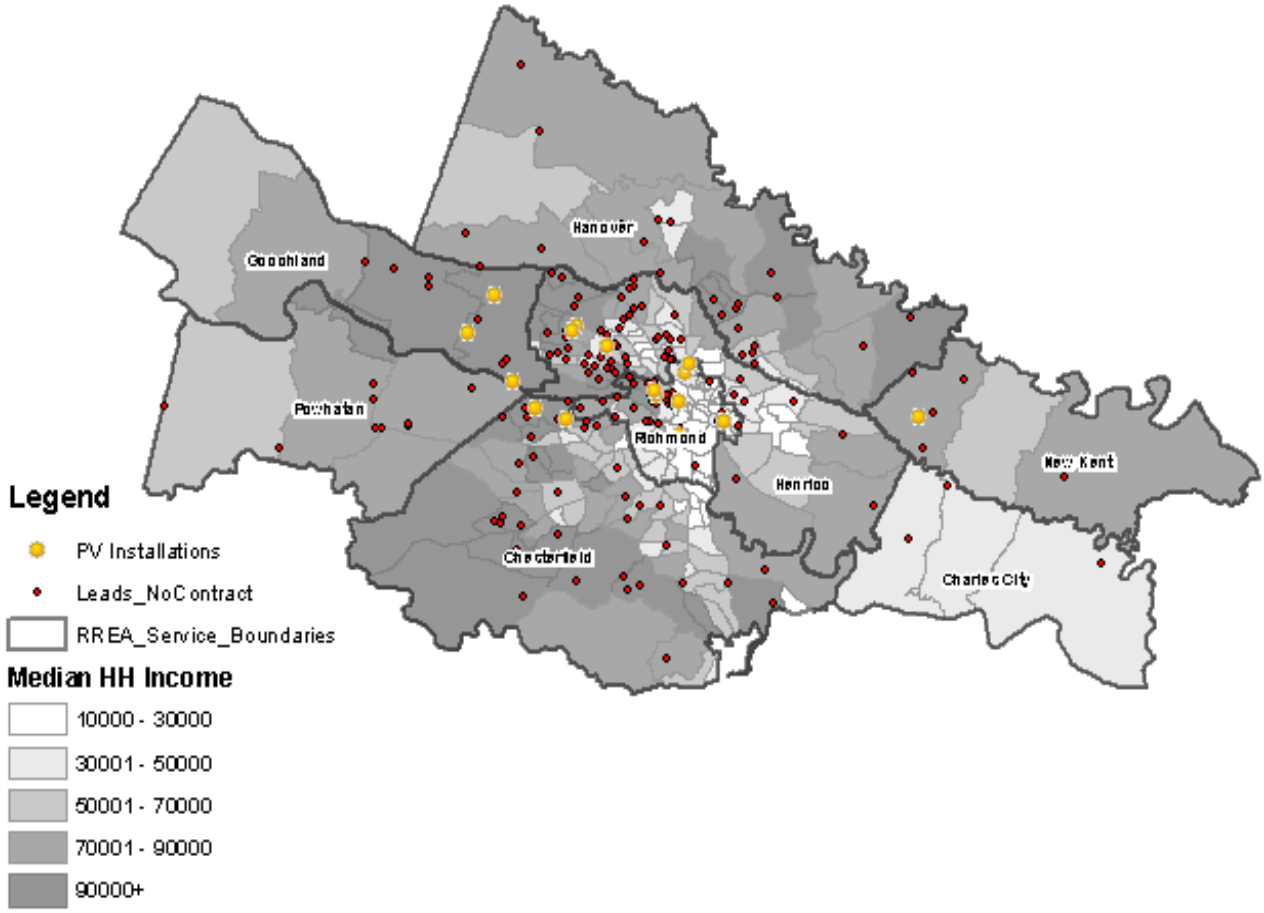
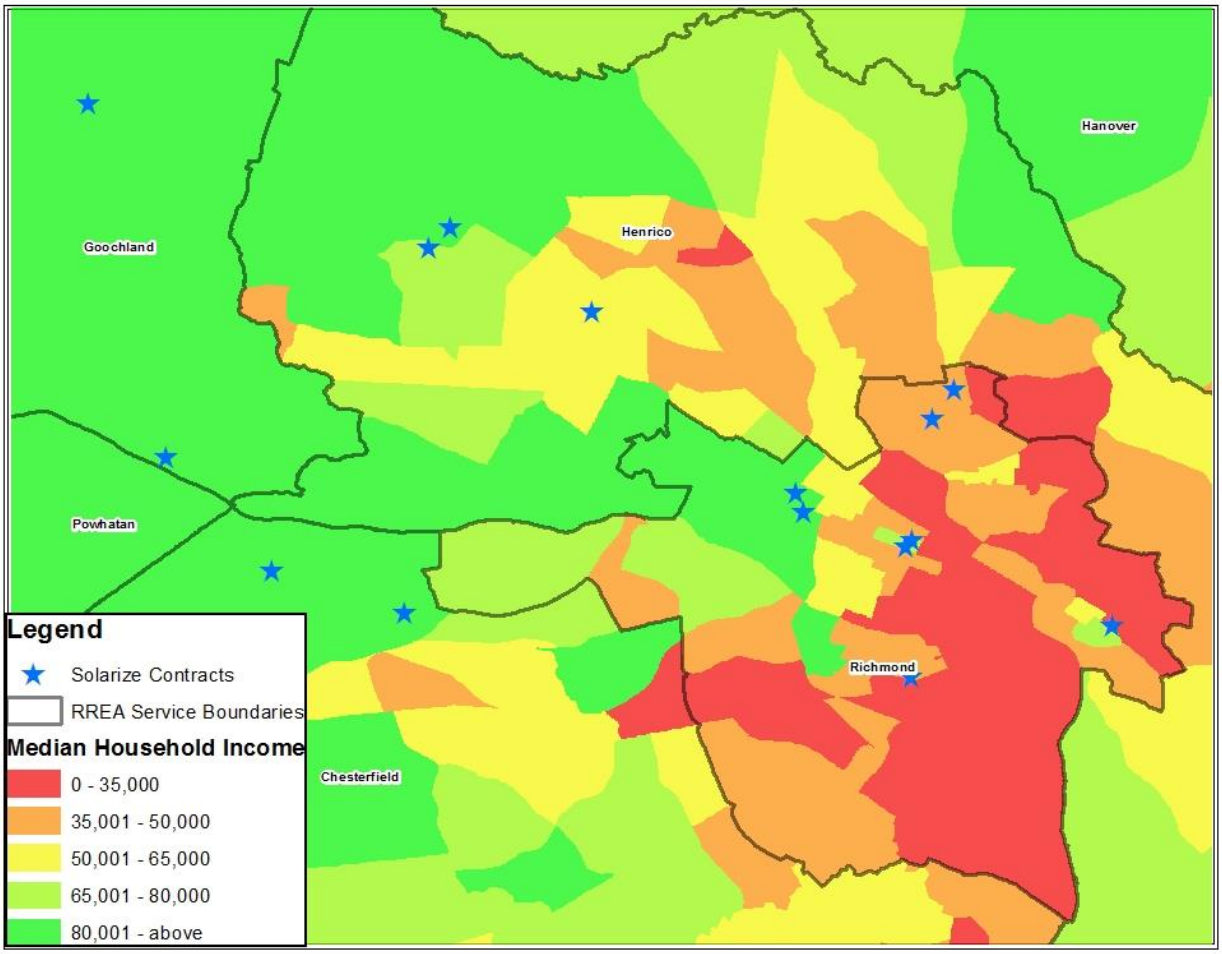


Figure 5. SolarizeRVA Leads and Installations by Income – Zoomed In



4.3 Case Studies

We also looked into the commercial solar sector to examine the scope of projects already implemented and what factors enabled their success. We searched for city-scale solar projects, as well as Solarize projects that incorporated small businesses. Unfortunately, we found that previous Solarize projects tend to focus solely on residential installations. We also investigated other collaboration efforts targeting businesses for solar PV, finding several examples. We ultimately selected three case studies representing three different approaches to promoting commercial solar at the city scale:

- A community Solarize program focused on the commercial sector
- A city-run solar development program focused on the commercial sector
- An entirely private sector model run by a non-profit organization

4.3.1 Case Study #1: Solarize Kingfield (Minneapolis, Minnesota)

The first phase of the Solarize Kingfield program, which ended in October 2011, was a solar installation program focused on local businesses and institutions, rather than homeowners. The Kingfield Neighborhood Association (KFNA), an organization based in a southwest community of Minneapolis, Minnesota, led this unique approach.[41] Similar to other Solarize programs throughout the nation, the Kingfield program helped businesses overcome the obstacles to installing solar PV systems.

A City of Minneapolis 2010–2011 Climate Change Innovation Grant helped support the project, as part of a city-wide sustainability initiative geared toward greenhouse gas reduction.[42] The project kicked-off with educational meetings organized by KFNA, with help and guidance from local solar installers. Utilizing aerial assessments, KFNA selected over twenty neighborhood businesses by which solar energy systems were seemingly feasible. KFNA conducted outreach to these business owners, and organized additional education sessions for those that showed interest in solar PV.[43]

KFNA paid for solar assessments and audits on the buildings of interested, and helped finance the cost of necessary structural assessments for the buildings. Two local Kingfield businesses ultimately opted to install a solar PV system. While information is unavailable on how the systems were financed, both businesses - Quality Coaches and Twin Town Guitars – would have had access to Xcel Energy's Solar Rewards program and the MN Bonus solar rebate program. Both of these programs aimed to further reduce installation costs as well as to encourage the businesses to purchase locally made PV system materials.[44]

The two businesses collectively installed solar PV arrays that amounted to 53 kW of power. The installations resulted in significant energy savings for both companies, and met the Climate Change Innovation program by collectively preventing 2,675,181 pounds of CO_2 emissions.[45] Overall, the Solarize Kingfield program helped reduce energy costs for the participating small business owners, as well as provided an illustration of how solar energy can work for firms in the Twin Cities area.

While the Solarize Kingfield approach may not be fully replicable for the Richmond region, there remain key strategies to glean from the process. The Solarize Kingfield program demonstrates a successful business-oriented Solarize tactic, indicating that such an approach can, in fact, work. Furthermore, not only can the Solarize process be applied exclusively to local businesses, but it can also be applied within a particular neighborhood. In this way, the program utilizes the strategy of peer diffusion and community cohesion to promote solar PV deployment.

4.3.2 Case Study #2: Solar@Work (San Francisco, California)

The Solar@Work model was developed by the City and County of San Francisco's Department of the Environment (SF Environment), in collaboration with the National Renewable Energy

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[41] Kingfield Neighborhood Association. (2011). *Solarize Kingfield*. Retrieved from: http://kingfield.org/solarize-kingfield/.

[42] Sparrow, R. (2014). *The sun always shines on Kingfield: The solarize Kingfield program*. Retrieved from: www.cleanenergyresourceteams.org/sites/default/files/publication_files/UGH.pdf.

[43] Ibid.

[44] Ibid.

[45] Ibid.

Laboratory (NREL), and Optony.[46] Initial research found that the main barriers to installing solar were up-front costs and a lack of financing. The project targeted small to mid-size business owners, who typically cannot afford to invest in solar. This research led to the aggregation approach utilized by Solar@Work, where multiple businesses merge into one group for purchasing group and a standardized lease. The WRI negotiated with solar vendors and selected the vendor (Solar City) who could best meet the needs expressed by San Francisco businesses.

NREL and Optony joined in the process and helped with technical assistance. The WRI then used its Collaborative Solar Procurement model to "create a suite of highly competitive financing options with Solar City, including an operating lease that can eliminate the upfront cost of going solar."[47] To facilitate the process, the WRI arranged for participants to receive a pre-negotiated discount. The incentive was to entice more people to participate, and if the project could get upwards of 3 MW of power purchased by the end of 2011, that would result in the largest reduction. At the time of the press release, 2 MW of power purchase was expected.

Several financing options were available through Solar@Work including cash purchases, solar leases, capital loans, etc. The program matched the buyer with appropriate financing, though not all businesses would qualify for all options. The program hoped to overcome the challenge of purchasing solar without subsidies.

As this project targeted small to mid-size business owners with an aggregate approach, the practices here are directly applicable to what SolarizeRVA could undertake in the Richmond region. The financing options and lease options were what helped Solar@Work succeed in getting costs down, in addition to any discounts achieved through bulk purchasing. If RREA could find financing assistance to give business owners additional options, costs could be lowered, making PV systems even more affordable.

4.3.3 Case Study #3: World Resources Institute - The Collaborative Solar Project

Released in 2011 by the World Resources Institute (WRI), *Purchasing Power: Best Practices Guide to Collaborative Procurement* outlines several different case studies of relevance.[48] A private-sector case study describes the very first attempt at collaborative commercial bulk purchasing of PV systems in the US. The intent of the project was to create a model that would reduce systems costs and increase operational efficiency.

Essentially, the WRI initiated a collaborative solar purchasing project for commercial solar projects in California. The project's goal was to install 1,000 MW of power by 2010. Early meetings uncovered concerns about fragmentation and high transaction costs, which led WRI to devise the pilot to see if collaborative purchasing could make solar PV more affordable. WRI conducted research on solar markets and financing options. They mapped roof space, pre-screening for feasibility before mapping, and they prepared and solicited a request for information (RFI) to give the local development industry time to get used to the idea of aggregate purchasing installations.

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[46] World Resources Institute. (2011, July 13). *Press release: San Francisco launches Solar@Work*. Retrieved from: http://www.wri.org/news/2011/07/press-release-san-francisco-launches-solarwork. p. 1

[47] Ibid. p. 3

[48] Goodward, J., Perera, A. & Lau, C. (2011, p. 47). *Purchasing power: Best practices guide to collaborative solar procurement*. Retrieved from: www.jointventure.org/images/stories/pdf/purchasing.power_best.practices.guide.to.collaborative.solar.procurement.pdf.

As a result of this process, the WRI has made note of lessons learned. Residential Solarize projects have found that the timeline becomes unpredictable when it is time for homeowners to commit and sign a contract; the same hurdles were present at the commercial level. WRI recommends establishing contingencies into the initial timeline to mitigate such circumstances. Additionally, they advocate key milestones so that involved parties know the deadlines for signing. They also recommend the timeline be approved by all decision makers and specified during procurement. Some participants backed out of the process, lowering the amount of solar being purchased below the threshold for aggregate pricing. The WRI was able to negotiate the pricing be honored if they could recruit more businesses to join in to fill the void.

There were unforeseen circumstances that prevented the process from progressing beyond bid analysis, though several businesses did end up going solar as a result of the groundwork done here. A decline in the real estate market, uncertainty on the part of investors about their ability to finance in the middle of a recession, and a decline in the value of the incentive provided by the California Solar Incentive (CSI) program[49] all impacted the pilot's outcome.

Through this initial pilot and other projects, the WRI established 12 steps in a best practices list specifically geared towards collaborative-purchasing commercial solar projects (see Figure 6).[50] These best practices follow the entire span of the project, from inception to completion. As they are based on a bulk purchasing for commercial applications, they are applicable to what the RREA and VA SUN is seeking to undertake in the Richmond region.

4.4 Local Business Interviews

Beyond total rooftop area analysis and outlining case studies of interest, we conducted in-depth interviews with local business owners to further understand opportunities for a commercial Solarize program in the Richmond region. We were interested in learning if local business owners were familiar with SolarizeRVA program facilitated earlier in the year. We believed that if we inquired about their current energy use and paired that with the Solarize model, we might pique their interest in such a program. However, we discovered that most business owners had not heard of the SolarizeRVA program. Additionally, there were mixed results concerning what extent business owners already knew about DPV and how it could impact their energy bills.

The manufacturing and food/beverage industries were selected as the industries on which to focus our efforts, after research indicated that these types of firms often have very high electricity demand, and thus may be interested in assuaging their monthly electric bills. We also contacted businesses who have publicly conveyed an interest in being "green" or sustainable. Another strategy employed was to focus on neighborhood business associations (i.e., focusing on geography rather than industry). This approach was inspired in part by academic research indicating the importance and influence of peer effects in solar installations.[51]

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[49] Ibid.

[50] Ibid. p. 18–20.

[51] See: Bollinger, B., & Gillingham, K. (2012). *Peer effects in the diffusion of solar photovoltaic panels.*

Figure 6. Best Practices for Collaborative Purchasing Solar Projects

Source: Goodward, Perera, & Lau, 2011

Several positive signs emerged from the interview process. First, several business owners expressed an interest in installing solar panels, particularly in the effort to reduce costly electricity bills, and especially if the payback period was small (most indicated three to five years as a desirable timeframe). Interviewees who were interested in the Solarize model and a potential commercial Solarize program in the Richmond region showed interest in attending information workshops or sessions organized by the RREA, in order to glean additional information.

"We would be interested in receiving more information about the program. We have a huge, south facing roof, so we would be good candidates if the cost would be right."

- David Gott, Owner, Legend Brewing Company

Some business owners seemed knowledgeable about how solar could benefit them, including savings on energy costs and reducing their carbon footprint.

"Yes, we have an interest in installing solar panels in the effort of saving energy and reducing our footprint. Would also like to lower electric bills over time."

-Jen Jackson, Owner, River City Cleaning

Some business owners claimed that they would be interested in paying the full up-front cost of the installation if it was affordable, though most expressed an interest in financing options.

"I have an interest in terms of lowering my utility bills; however, I am concerned about the real payback time."

-Stephen Lord, Owner, The Cleaning Authority, LLC

Some of the challenges we experienced included difficulty getting in contact with the appropriate parties. For instance, we found that while most Richmond region breweries are locally owned, most of those owners do not keep regular hours and are difficult to reach. Further, there is a large corporate presence in the Richmond region, with businesses such as Kraft, Pepsi-Cola Bottling, Nabisco, Sabra, etc. These types of businesses often require corporate buy-in and increased time to arrange such a project due to the process of approval innate in a corporate structure. This was the case with some non-corporate businesses as well, however.

"I do not own the building that we operate from, so this would not be a good fit."

-John Newton, Sales Engineer, Jobe & Company, Inc.

"You will have to talk to our corporate Operations Manager."

-Mike Romanchik, Branch Manager, State Electric Supply Co.

As anticipated, cost was a central concern for several business owners, particularly small businesses. Concerns about the cost of solar PV was and a lack of knowledge about the technology seemed to dominate several interviews.

"I do love the idea of solar power but the cost is so high right now to install the panels and batteries. I have a contractor friend who has considered it for his barn…but even with him installing it, the cost is still about $30k…ouch!"

-Melissa Simmons, Founder and CEO, Tailored Touches, LLC

"I am too small to be realistic enough to gather usable data…our business could not afford solar panels right now."

-Isara Serene, Owner, Serene Suds

We also found that several business owners were not familiar with the recent SolarizeRVA program or Solarize programs in general. Thus, it would be beneficial to engage in more outreach in order to educate the public and generate interest in solar energy.

"I have never heard of the SolarizeRVA program."

- Judy Harr, Owner, Extra Billy's Smokehouse and Brewery

A lack of knowledge about solar PV energy in general is also an obstacle, as there was a wide variety of responses indicating different levels of solar literacy. Educational outreach would be a valuable part of a commercial SolarizeRVA program, in the effort of educating business owners about solar energy, how it could benefit them, and what installing solar PV panels would entail.

"I wouldn't even know how to begin thinking about the kind of solar payback time I would need. I really don't know a whole lot about it. Doesn't that take like 20 or 30 years or something like that?
- Judy Harr, Owner, Extra Billy's Smokehouse and Brewery

Lastly, we focused on geography, contacting area business associations to see if any of their members businesses would be interested in solar. Specifically, we contacted the Fan Area Business Alliance, Scotts Addition Business Association, Lakeside Business Association, and the Shockoe Partnership. In contacting these associations, several of their leaders were quick to point out that most of their member organizations were very small or operated out of buildings owned by someone else. Of the two businesses that were reached, HMA Lab Supply and Pressure Works Inc., interviewees generally implied a lack of information concerning solar, as well as a lack of interest.

There have also been interview concerns from the perspective of the solar installer, such as the fact that Solarize "programs effectively reduced prices for customers at the expense of the contractors' profit margins."[52] Though these margins were somewhat alleviated by increased business, there have still been concerns from contractors in Virginia suggesting that such short-term spikes in business is unsustainable.[53] Despite such findings and challenges, we maintain belief that local contractors would be pleased to have business as a result of a commercial Solarize program in the Richmond region.

Overall, the interview process helped to understand some of the challenges and obstacles associated with deploying DPV into the commercial sector. Interestingly enough, some of these challenges were addressed in a recent webinar conducted by VA SUN and the Virginia Green Travel Alliance. The webinar was an educational outreach attempt to impart information and get a read on interest and obstacles. Participants were from a variety of businesses within the Richmond region.

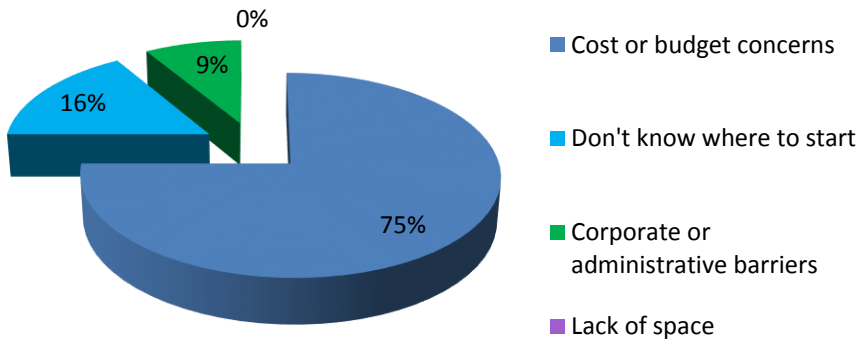
During the webinar, speakers Tom Griffin and Aaron Sutch polled participants on a few such obstacles. Cost seems to be the biggest deterrent to installing solar PV for local businesses. Figure 7 summarizes potential restraints. When asked what was holding them back from solar investments, business owners answered:

- 69% - cost or budget concerns
- 15% - don't know where to start
- 8% - corporate or administrative barriers
- 0% - lack of space
- 8% - other

[52] Pitt, D., Michaud, G. (2014). *Planning and permitting for solar energy: Evaluation of "Solarize" programs in Virginia*. Submitted to the Association of Collegiate Schools of Planning (ACSP) 54th Annual Conference. p. 11.

[53] Ibid.

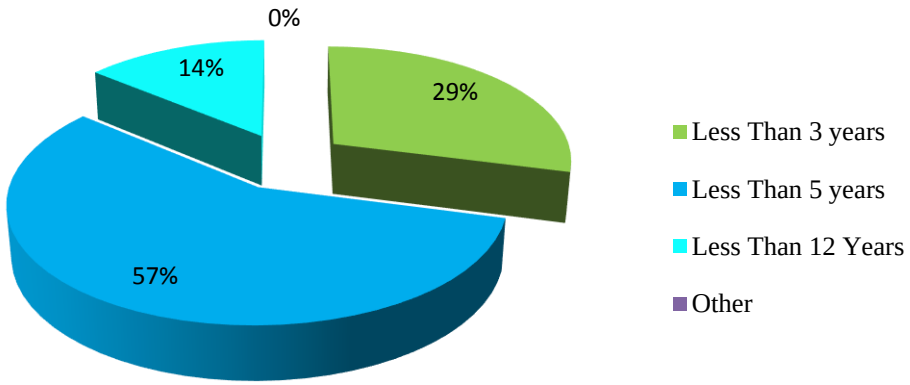
Figure 7. Obstacles for Local Businesses



In further discussing cost concerns, business owners were asked about the time to recoup their investment to make if feasible for them to invest in solar PV. Figure 8 summarizes the responses when asked about the return on investment (ROI) business owners needed with regard to solar installations. When asked about the sort of ROI business owners needed from solar, attendees answered as follows:

- 29% - less than 3 years
- 57% - less than 5 years
- 14% - less than 12 years
- 0% - other

Figure 8. Timeline of Return on Investment (ROI) by Business Owners



This information was gathered from a small number of business owners in the Richmond region. However, it suggests that cost is the biggest impediment to solar PV investments. Most businesses desire an ROI of 5 years or less, though a small percentage of businesses desire 12 years or less. This reinforces the information found in our case studies.

5. Conclusions and Recommendations

The first phase of the SolarizeRVA program, focused on residential applications, was successful at generating hundreds of customer leads and, ultimately, over 100 kW worth of signed solar PV contracts within the Greater Richmond, Virginia region. This research has showed that a second phase of the SolarizeRVA program, specifically focused on commercial rather than residential solar, can, in fact, be a successful venture. The GIS analysis indicates that lack of rooftop space is a not an issue, as over 25% of rooftop space in the core counties is commercial rooftop, totaling over 174 million square feet.

Additionally, the findings from the mapping and solar energy installation scenarios lead us to believe that there is tremendous potential for solar energy development on commercial rooftops in the Richmond region. Installing solar PV on only 0.1% of the available commercial rooftop space would result in 2.75 MW of installed capacity and nearly 3.4 million kWh of electricity per year. This is enough to power over 250 homes, and the resulting 1,663 metric tons of GHG emissions savings would be equivalent to taking 560 cars off of the road.

Our three case studies examined three different approaches for deploying solar PV in the commercial sector: a Solarize program run by a neighborhood association in Minneapolis, a public sector initiative by the City of San Francisco, and a privately run bulk purchase model envisioned by the World Resources Institute. In all three case studies, the program organizers took a variety of steps to ease the decision-making process for potential commercial solar customers, such as by mapping the target area and pre-screening potential buildings to identify prime locations for solar power systems, and by establishing a variety of financing options for the local business owners to consider.

Our interviews indicate that there exists a major opportunity to market SolarizeRVA to businesses. Most, if not all, of the business owners we spoke to were not familiar with the SolarizeRVA program, despite the program's success in the residential sector. Therefore, RREA and VA SUN need to further engage business owners and the greater citizenry to create interest in such a project. This can be done through public relations, marketing, and other grass-roots efforts. The Solarize Kingfield case study, for instance, offers much information and examples on public outreach ideas. Here, the KFNA did a "streetscape solar tour," engaging the public with food booths, interactive models, etc. Models of solar panels set up for attendees to view, and vendors were present so that people could interact with them and ask questions. While this is merely one example, it was a successful educational outreach program that helped businesses better understand the Solarize model. The RREA and VA SUN could potentially organize a similar event in the Richmond region.

There interviews did note several concerns, however. Several businesses are not operated by the actual owners, meaning that extra time is needed for the interaction between manager, owner, and Solarize program organizers. Additionally, while several businesses have large facilities and could be good candidates for DPV installations, they are owned by larger, corporate entities and would likewise require more time in overcoming such hurdles. Other logistical challenges include the fact that several business managers do not seem to keep regular business hours, making them difficult to reach. We conclude that small to mid-sized businesses would be the best focus for further outreach, most likely in the range of 50–100 employees and 20–50 million dollars of revenue per year.

The vast majority of interviewees mentioned cost concerns, indicating that this is by far the largest obstacle to commercial-sector DPV investment. However, as noted in the case study analysis, if a new, commercially-focused SolarizeRVA program can negotiate a big enough reduction in hard costs, it could probably get several businesses on board. Most business owners who were familiar with

solar expressed a need for five year or less ROI, as shown in both our interviews and the webinar poll conducted by the Virginia Green Travel Alliance and VA SUN.

We also conclude that there is an overall lack of energy literacy among Richmond region businesses. Most business owners contacted were not well educated on what proportion of their company's overhead was energy or electricity related. Similarly, few knew if this amount seemed to fluctuate seasonally, or if it was fairly consistent year round. Therefore, moving forward, RREA and VA SUN should continue to help business owners become more cognizant of how energy costs affect their business, particularly considering recent rising energy costs in the Dominion territory and the projections for such costs to continue rising in the future. It is also important to about the available financial incentives for DPV systems, from the state government or through Dominion, as part of their outreach process.

Solarize programs offer a unique approach for home or business owners to invest in solar PV energy systems. Though DPV installations are a growing trend in the US today, there still remain key challenges toward effective installation and deployment. In addition, while there are a number of financial incentives available to interested parties in the Richmond region, Virginia still lags behind its neighboring states in terms of both financial incentives and resulting DPV capacity. Further research is needed into the possibilities and barriers for a commercial-sector Solarize program in the Richmond region in order to determine the best path(s) forward given Virginia's unique regulatory landscape, particularly with regard to ways to continue to reduce costs. Aerial assessments could help identify businesses to target in the outreach process. Additional research is also necessary in terms of business owner interests and concerns, as our sample size for the interview process was relatively small. Considering the scope and influence of RREA and VA SUN, the organizations should continue to gauge interest among local business owners in the future.

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Appendix A. Interview Responses

Interview Response #1
Jen Jackson, Owner, River City Cleaning
1206 S Meadow St, Richmond, VA 23220
(804) 921-0243

1. **First and foremost, do you literally own the building that you operate in? Do you pay the utility bills?**

NO, I RENT. I PAY GAS AND ELECTRIC BILL, WATER IS INCLUDED

2. **Does your company have any interest in installing solar panels? Why or why not?**

YES. SAVING ENERGY AND REDUCING OUR FOOTPRINT, POSSIBLY HAVING LOWER BILLS OVER TIME. WE ARE OUTGROWING OUT CURRENT SPACE, AND I WOULD WANT TO WAIT A YEAR OR TWO BEFORE MAKING ANY INVESTMENTS - JUST TO MAKE SURE WE ARE NOT LEAVING THE AREA TO FIND A NEW PROPERTY BECAUSE OF THE GROWTH OF OUR COMPANY.

3. **How long of a payback period would you expect if you were to invest in solar? In other words, how long would you be willing to wait for the savings on your energy bill to make up for the initial investment?**

2–3 YEARS

4. **If you were to invest in solar, would you be more likely to pay the full cost up-front or pursue some type of financing option?**

FINANCING OPTIONS….OR FULL COST UP FRONT IF IT WAS AFFORDABLE

5. **If you feel comfortable with sharing, what proportion of your company's overhead would you estimate is energy or electricity related? Does this amount fluctuate seasonally or is it fairly consistent year round?**

I AM NOT AWARE THE PERCENTAGE OF OVERHEAD THAT GOES TO ELECTRIC. WE HAVE JUST MOVED TO A NEW LOCATION IN THE PAST MONTH. I AM ASSUMING IT FLUCTUATES SEASONALLY.

6. **Are you familiar with the recent SolarizeRVA program? Solarize programs in general?**

NO, NOT FAMILIAR WITH RECENT SOLARIZERVA PROGRAM. BUT THIS IS GREAT, PLEASE KEEP ME INFORMED. THE OWNER OF THIS BUILDING IS A GREAT GUY AND MIGHT BE INTERESTED. ALSO, THERE ARE 3–4 OTHER BUSINESSES IN THIS BUILDING

COMPLEX THAT MIGHT BE ON BOARD AND INTERESTED IN SEEING SOMETHING LIKE THIS HAPPEN.

7. Do you have any additional questions, concerns, or reservations about investing in solar energy, in general?

WHAT IS THE COST? HOW DO PEOPLE GET SET UP WITH THIS? I AM ASSUMING SOMEONE WOULD NEED TO COME OUT AND ASSESS THE BUILDING BEFORE THE COST WOULD BE DETERMINED.

8. Would you be interested in participating in this program?

YES! THIS IS IMPORTANT TO ME AS A BUSINESS OWNER AND I WOULD LIKE TO BE A PART OF THE PROGRAM EVENTUALLY.

Interview Response #2

Stephen Lord, Owner, The Cleaning Authority, LLC
3919 Deep Rock Road, Henrico, VA 23233
(804) 273-0757

1. **First and foremost, do you literally own the building that you operate in? Do you pay the utility bills?**

YES AND YES

2. **Does your company have any interest in installing solar panels? Why or why not?**

I HAVE AN INTEREST IN TERMS OF LOWERING MY UTILITY BILLS; HOWEVER, I AM CONCERNED ABOUT THE REAL PAYBACK TIME.

3. **How long of a payback period would you expect if you were to invest in solar? In other words, how long would you be willing to wait for the savings on your energy bill to make up for the initial investment?**

5 YEARS

4. **If you were to invest in solar, would you be more likely to pay the full cost up-front or pursue some type of financing option?**

DEPENDS ON THE RATE.

5. **If you feel comfortable with sharing, what proportion of your company's overhead would you estimate is energy or electricity related? Does this amount fluctuate seasonally or is it fairly consistent year round?**

8 PERCENT – THIS IS FAIRLY CONSISTENT.

6. **Are you familiar with the recent SolarizeRVA program? Solarize programs in general?**

WAS NOT FAMILIAR, THANK YOU FOR THE ADDITIONAL INFORMATION.

7. **Do you have any additional questions, concerns, or reservations about investing in solar energy, in general?**

TWO MAIN CONCERNS ARE RELIABILITY AND PAYBACK TIME.

8. **Would you be interested in participating in this program?**

MAYBE – WOULD BE INTERESTED IN LEARNING MORE ONCE THE PROGRAM BEGINS.

Interview Response #3

Judy Harr, Owner, Extra Billy's Smokehouse and Brewery
1110 Alverser Dr., Midlothian, VA 23113
(804) 379-8727

1. **First and foremost, do you literally own the building that you operate in? Do you pay the utility bills?**

YES, I AM THE OWNER. THE BUILDING USES BOTH GAS AND ELECTRIC.

2. **Does your company have any interest in installing solar panels? Why or why not?**

NOT REALLY, IT'S TOO EXPENSIVE.

3. **How long of a payback period would you expect if you were to invest in solar? In other words, how long would you be willing to wait for the savings on your energy bill to make up for the initial investment?**

I HAVE NO IDEA, MAYBE 5 YEARS?

4. **If you were to invest in solar, would you be more likely to pay the full cost up-front or pursue some type of financing option?**

NEITHER, IT'S TOO EXPENSIVE.

5. **If you feel comfortable with sharing, what proportion of your company's overhead would you estimate is energy or electricity related? Does this amount fluctuate seasonally or is it fairly consistent year round?**

MAYBE 10% OR LESS? I HAVE NO IDEA.

6. **Are you familiar with the recent SolarizeRVA program? Solarize programs in general?**

NO, I HAVE NEVER HEARD OF THESE.

7. **Do you have any additional questions, concerns, or reservations about investing in solar energy, in general?**

NO, I DON'T REALLY KNOW ENOUGH ABOUT IT TO ASK.

8. **Would you be interested in participating in this program?**

I WOULD BE INTERESTED IN GETTING MORE INFORMATION ABOUT SOLAR, BUT THAT MIGHT BE ABOUT IT.

Interview Response #4
David Gott, Owner, Legend Brewing Company
321 W. 7th St., Richmond, VA 23224
(804) 232-8871

1. **First and foremost, do you literally own the building that you operate in? Do you pay the utility bills?**

YES, OWN BUILDING. BUILDING USES BOTH GAS AND ELECTRIC.

2. **Does your company have any interest in installing solar panels? Why or why not?**

YEAH, IF IT WAS FREE!

3. **How long of a payback period would you expect if you were to invest in solar? In other words, how long would you be willing to wait for the savings on your energy bill to make up for the initial investment?**

PROBABLY 25–30 YEARS.

4. **If you were to invest in solar, would you be more likely to pay the full cost up-front or pursue some type of financing option?**

NEITHER, IT WOULD NOT BE COST EFFECTIVE AT THIS TIME.

5. **If you feel comfortable with sharing, what proportion of your company's overhead would you estimate is energy or electricity related? Does this amount fluctuate seasonally or is it fairly consistent year round?**

I HAVE NO IDEA WHAT THAT PERCENT WOULD BE.

6. **Are you familiar with the recent SolarizeRVA program? Solarize programs in general?**

NO, HAVE NEVER HEARD OF IT.

7. **Do you have any additional questions, concerns, or reservations about investing in solar energy, in general?**

JUST THE COST…

8. **Would you be interested in participating in this program?**

WOULD BE INTERESTED IN RECEIVING MORE INFORMATION ABOUT THE PROGRAM – WE HAVE A HUGE, SOUTH FACING ROOF SO WE WOULD BE GOOD CANDIDATES IF THE COST WOULD BE RIGHT.

Interview Response #5

John Mulke, President, HMA Lab Supply
3435 W. Leigh St., Richmond, VA 23224
(804) 353-9499

1. **First and foremost, do you literally own the building that you operate in? Do you pay the utility bills?**

NO, WE DO NOT OWN THIS BUILDING

2. **Does your company have any interest in installing solar panels? Why or why not?**

MAYBE, IF WE EXPANDED AND BOUGHT OUR OWN BUILDING

3. **How long of a payback period would you expect if you were to invest in solar? In other words, how long would you be willing to wait for the savings on your energy bill to make up for the initial investment?**

5 YEARS

4. **If you were to invest in solar, would you be more likely to pay the full cost up-front or pursue some type of financing option?**

FINANCING OPTION

5. **If you feel comfortable with sharing, what proportion of your company's overhead would you estimate is energy or electricity related? Does this amount fluctuate seasonally or is it fairly consistent year round?**

I AM NOT SURE AT THE MOMENT

6. **Are you familiar with the recent SolarizeRVA program? Solarize programs in general?**

I HAVE NEVER HEARD OF THIS, CAN YOU EXPLAIN IT SOME

7. **Do you have any additional questions, concerns, or reservations about investing in solar energy, in general?**

NO, I DO NOT

8. **Would you be interested in participating in this program?**

NOT AT THIS TIME