Renewable Energy Development in Charlottesville, Virginia: Policy Solutions for Overcoming Market Barriers

Prepared for Charlottesville Renewable Energy Alliance

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GLOSSARY

APCo: Appalachian Power Company
RAC: Rate adjustment clause
RPS: Renewable Energy Portfolio Standard
SCC: State Corporation Commission

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EXECUTIVE SUMMARY

As climate change presents an imminent threat to the global community, many nations, states, and localities have enacted policies to encourage an increase in energy generation from renewable sources. Sources of renewable energy include solar, wind, biomass, geothermal, and hydroelectric power. In the United States, state policies have driven renewable energy development. As a result, renewable energy has become less expensive and more reliable in recent years (Barbose, 2017).

Historically, the Commonwealth of Virginia has enacted public policies that stifled renewable energy development. However, the 2018 Session of the General Assembly brought about sweeping changes intended to bolster renewable energy production in the Commonwealth. While Virginia's new legislation encourages renewable energy development, the incentives in the law largely benefit the established traditional utilities in the Commonwealth. The legislation does not contain provisions that sufficiently support third-party developers of renewable energy technology, such as clean technology startups and entrepreneurs. These third-party developers, located in Charlottesville and other cities across Virginia, can offer new and innovative renewable technology solutions that help achieve the Commonwealth's sustainability goals. Due to the substantial influence of incumbent utilities, third-party developers of clean energy technologies in Charlottesville still face market barriers to the renewable energy sector.

This analysis, prepared for the Charlottesville Renewable Energy Alliance, considers potential interventions to reduce market barriers for third-party renewable developers. These interventions would be executed by the Charlottesville Renewable Energy Alliance. The analysis evaluates four options: (1) establish a clean technology incubator in Charlottesville; (2) advocate for replacing Virginia's current voluntary Renewable Energy Portfolio Standard (RPS) policy with a mandatory RPS; (3) launch an information campaign to education citizens about renewable options; and (4) let present trends continue. These alternatives will be analyzed using the following criteria: cost to the Charlottesville Renewable Energy Alliance, effectiveness, feasibility, and sustainability.

This analysis recommends that the Charlottesville Renewable Energy Alliance works to establish a clean technology incubator in Charlottesville. A clean technology incubator supports startups and entrepreneurs by providing a physical workspace, industry expertise, a network of investors, and other resources to help bring new technologies to the marketplace. It is also recommended that the Alliance implements the incubator program in the Charlottesville Technology Center, an innovation hub that will be under construction beginning in the summer of 2018. This solution will effectively address the market barriers for third-party renewable developers and advance the mission of the Charlottesville Renewable Energy Alliance.

PROBLEM STATEMENT

In initial efforts to combat global warming and climate change, many nations, states, and localities have focused on reducing greenhouse gas emissions. While there are several sources of emissions, the energy sector is the largest contributor worldwide. In 2010, energy production and use (including fuel for vehicles) accounted for roughly 70 percent of global emissions (Environmental Protection Agency, 2016). In order to reduce emissions from the energy sector, many governments and organizations have adopted policies to encourage an increase in energy generation from renewable sources. Sources of renewable energy include solar, wind, biomass, geothermal, and hydroelectric power.

In the United States, there is no federal legislation requiring energy generation from renewable sources. Some federal laws, such as the Energy Policy Act of 2005, provide tax breaks as incentives for renewable energy use and development (Cunningham, 2016). While these federal policies have helped created a market for renewable energy technologies, many states legislatures have enacted policies that go further. State policies have driven renewable energy development across the country, making renewable energy less expensive and more reliable in recent years (Barbose, 2017). The success of these state policies is reflected in nationwide market trends; for example, the market for solar energy technologies grew 97 percent from 2015 to 2016 (Perea et al., 2017).

Despite effective policy interventions in many states, other states have fallen behind in renewable energy development. According to the U.S. Department of Energy, Virginia ranked 37th among the states for the percentage of energy produced from renewable sources in 2015 (U.S. Department of Energy, 2015). For many years, Virginia enacted public policies that stifled renewable energy development. These policies were championed by Dominion Energy Virginia (Dominion) and Appalachian Power Company (APCo), the two largest electric utilities serving the Commonwealth. Dominion, in particular, maintains substantial political influence over the General Assembly; the corporation is the largest political donor in Virginia (Schneider, 2018).

However, the political landscape surrounding energy policy in Virginia is changing. The 2018 Session of the General Assembly brought about sweeping changes intended to bolster renewable energy production in the Commonwealth. In the face of new state policies, cities and localities will need to adapt. This analysis, prepared for the Charlottesville Renewable Energy Alliance, will focus on how Virginia's renewable energy policies impact development in the City of Charlottesville.

Although Virginia's new statewide policies are designed to encourage renewable energy development across the Commonwealth, the majority of the incentives exist to benefit Dominion and APCo. Due to the established influence of Dominion and other incumbent utilities, third-party developers of clean energy technologies in Charlottesville still face market barriers to the renewable energy sector.

OVERVIEW OF ENERGY REGULATION IN VIRGINIA

The history of energy regulation in Virginia reflects the complex nature of the industry. In order to understand the impact of Virginia's new energy policies on development in Charlottesville, it is important to consider the historical context and the major changes to the regulatory framework over time.

In general, public utility regulation exists for the purpose of consumer protection. In any unregulated marketplace, competition is the mechanism that sets prices at a reasonable level. However, utilities are considered natural monopolies; due to the public need for the electrical service, and the massive costs associated with producing and distributing this service, one or two major firms emerge to provide the service in a given area. Thus, there is little to no competition to regulate prices. Without government regulation to protect consumers, public utilities would be allowed to charge their customers at any rate to promote their own economic interests (Brasfield, 1973). Additionally, utility companies provide a necessary service to consumers—electricity. Since consumers are essentially required to purchase electricity, and can only purchase the service from the utility in their area, it would be unfair for the utility company to incur substantial profits from this transaction. Regulation ensures that utility companies do not earn an unreasonable profit for their necessary service (Brasfield, 1973).

In Virginia, the State Corporation Commission (SCC) is responsible for regulating electric utilities. The SCC enacts regulations for utility rates and charges, facilities, areas of service, and financial affairs (Brasfield, 1973). The SCC regulates the Commonwealth's major, monopolistic utilities: Dominion Energy Virginia, Appalachian Power Company, and Old Dominion Power. These are investor-owned, for-profit utility companies. The SCC also regulates the Commonwealth's 13 electric cooperatives, which are non-profit entities owned by the consumers they serve (State Corporation Commission, n.d.). Dominion, the largest investor-owned utility, is responsible for the vast majority of electricity generation in the Commonwealth. Figure 1 below shows that the top five retailers of electricity in Virginia provided 91 percent of all electricity sold in the state in 2016; Dominion alone accounted for 68 percent of total electricity sales (U.S. Energy Information Administration, 2016).

Figure 1: Top Five Retailers of Electricity in Virginia, 2016

	Entity	Type of provider	Sales (megawatthours)
1	Dominion Energy Virginia	Investor-owned	76,291,891
2	Appalachian Power Co	Investor-owned	15,367,593
3	Northern Virginia Elec Coop	Cooperative	4,380,900
4	Rappahannock Electric Coop	Cooperative	4,019,169
5	Shenandoah Valley Elec Coop	Cooperative	2,386,548
	Total sales, top five providers		102,446,101
	Percent of total state sales		91

Source: U.S. Energy Information Administration, Form EIA-861, "Annual Electric Power Industry Report."

Thus, while other options exist, Dominion and APCo serve the vast majority of Virginians; they are also the major players affected by utility regulation.

Periods of Regulation

To understand the historical context of utility regulation in Virginia, it is important to recognize three distinct time periods: regulation prior to 1999, deregulation from 1999 to 2007, and re-regulation after 2007.

Before 1999, the SCC had authority to regulate electric utilities under Chapter 10 of Title 56 of the code of Virginia. Each utility entered a regulatory compact with the SCC; these agreements allowed the SCC to regulate a utility in exchange for a monopoly service territory. Chapter 10 regulation allowed the SCC to set electric utility rates and the rate of return, or profit level, for utility companies (GreeneHurlocker, 2017). Under Chapter 10, the SCC was required to determine just and reasonable utility rates based on the utilities' costs of service.

Throughout the 1990s, many states started to deregulate their energy sectors. This allowed consumers in those states to buy energy from competitive suppliers rather than their incumbent monopoly utilities (GreeneHurlocker, 2017). In 1999, the General Assembly passed legislation to begin the deregulation process for the energy sector in Virginia. This law, called the Virginia Electric Utility Restructuring Act of 1999, included a rate freeze that would keep electricity prices low until other suppliers entered the market to establish competition (Casey, 2018). However, no new suppliers emerged.

After deregulation proved unsuccessful, the General Assembly passed the 2007 Re-Regulation Act. This law established a new system that greatly differs from the previous regulation under Chapter 10. While Chapter 10 represents a traditional regulatory system, the 2007 Re-Regulation Act is unique to Virginia (GreeneHurlocker, 2017). The legislation only applies to Dominion and APCo, the investor-owned monopoly utilities (GreeneHurlocker, 2017).

First, the Re-Regulation Act changes the procedures for reviewing each utility's rates and profits (GreeneHurlocker, 2017). Per the new procedures, utilities' rates and profits are only reviewed every two years in biennial review rate cases. During these review cases, the SCC analyzes the utilities' costs and revenues for the previous two-year period. Based on this information and projected future expenses, the SCC determines the utilities' appropriate rate of return for the next two years. The SCC can also order Dominion and APCo to refund customers if they have overcharged in the past two years, but only in limited circumstances (GreeneHurlocker, 2017).

The Re-Regulation Act also includes several financial incentives and bonuses for the utilities. Among these incentives are rate adjustment clauses (RACs), which allow Dominion and APCo to recover costs of certain projects. For any project that qualifies for cost recovery through a RAC, the utility is guaranteed reimbursement for all costs associated with the project in addition to a rate of return (GreeneHurlocker, 2017). Importantly, customers bear the burden of these costs; a monthly utility bill includes base rate charges and RAC charges. In 2017, RAC charges accounted for about 40 percent of a typical customer bill (GreeneHurlocker, 2017).

In addition to the incentives provided by RACs, the Re-Regulation Act also limits the SCC's ability to reduce rates. The SCC is only authorized to reduce base rates if the utilities' earnings were more than 0.7 percent above authorized earnings for two consecutive biennial review periods, or four consecutive years (GreeneHurlocker, 2017). In practice, this benefits utilities by limiting the authority of the SCC.

The Re-Regulation Act also includes a voluntary renewable energy portfolio standard (RPS) program for APCo and Dominion (GreeneHurlocker, 2017). RPS programs are a common approach to reducing emissions and spurring renewable energy development; twenty-nine states and the District of Columbia have enacted a mandatory RPS (Heeter et al., 2014). Mandatory RPS programs require that a certain percentage of a utility's electricity sales must come from renewable sources over a given time period. However, Virginia's RPS is voluntary, so the utilities are not required to meet the goals.

Since 2007, the General Assembly has passed many amendments to the Re-Regulation Act. These amendments primarily focus on the process of calculating earnings for biennial review rate cases (GreeneHurlocker, 2017). Amendments passed in 2013 and 2014 effectively reduced utilities' reported earnings, which further limited the SCC's ability to reduce base rates or order refunds to customers. According to the Virginia Attorney General's Office, the 2014 amendment allowed Dominion to retain about $188 million in excess profits that would have been refunded to customers otherwise (GreeneHurlocker, 2017).

In 2015, the General Assembly also passed SB 1349 to amend the Re-Regulation Act. This amendment, often referred to as the "rate freeze bill," prohibited the SCC from reducing Dominion's and APCo's rates for several years. Per this amendment, the SCC could not reduce base rates even if they determined the rates were too high. In a 2017 report, the SCC found that APCo earned roughly $28 million in excess profits above its designated rate of return in 2016. For the same year, Dominion's excess profits amounted to approximately $252 million (GreeneHurlocker, 2017). This report received significant attention and prompted the General Assembly to consider new legislation in the 2018 Session.

Recent Policy Action

Throughout the 2018 Session of the General Assembly, energy policy and regulation emerged as a main focus. As a result, the General Assembly passed an omnibus energy bill, referred to as HB 1558 in the House of Delegates and SB 966 in the Senate, to amend the Re-Regulation Act. This legislation contains several important provisions to update the regulatory model and invest in renewable energy priorities. First, the law overturns the 2015 "rate freeze" amendment to the Re-Regulation Act that allowed Dominion and APCo to overcharge customers without intervention from the SCC. Repealing this controversial amendment was the main driver of the omnibus bill (Weaver, 2018). The new legislation also requires Dominion to refund $200 million back to its customers for the excess profits earned in recent years. APCo is required to refund $10 million to its customers in the form of fuel credits. (Cleveland, 2018).

Next, the law provides for investments of over $1 billion in energy efficiency. Dominion is required to allocate $870 million for energy efficiency projects through 2028, and APCo is required allocate $140 million (Cleveland, 2018). The law also requires significant investment in cost-effective renewable energy development (Shepherd, 2018). It declares that 5,000 megawatts of solar and wind power are in the public interest (Cleveland, 2018). The law also specifies that 50 megawatts of rooftop solar installations and 16 megawatts of offshore wind projects are in the public interest (Cleveland, 2018). Additionally, the law provides for investment in grid modernization, which involves updating the infrastructure of the electric grid with cutting-edge technology to maximize energy derived from renewable sources, battery storage, and demand response (Shepherd, 2018).

Modernizing the grid with smart meters and other new technologies will result in lower energy costs statewide and lower pollution (Shepherd, 2018). The funding mechanism for investment in renewable development and grid modernization is called the Customer Credit Reinvestment Offset, which requires Dominion and APCo to invest 100 percent of their remaining excess earnings into these projects (Cleveland, 2018). Collectively, these investments in the three priorities of energy efficiency, renewable energy development, and smart grid modernization will propel the Commonwealth toward a more sustainable energy future.

Some other features of the law are summarized below:

- The SCC will complete review rate cases every three years, rather than every two years.
- The SCC will evaluate over-earnings from 2017 in the 2021 review rate case for Dominion and in the 2020 review rate case for APCo.
- The SCC reclaims the authority to reduce base rates in every single rate case.
- Utilities are allowed to expense certain costs against earnings in one review period; in practice, this gives control to utilities that will make it more difficult for the SCC to find over-earnings in any future review rate case.
- The law authorizes two pilot projects for undergrounding transmission lines (Cleveland, 2018).

Though the legislation is widely regarded as a successful advancement toward energy efficiency and clean energy, it has received some criticism. Consumer advocates maintain that the law does not require sufficient refunds of excess earnings from Dominion to customers (Shepherd, 2018). Other critics argue that the law is too vague, with many provisions left to interpretation by Dominion. Further, the law authorizes billions of dollars in spending, but it was hastily passed in a few weeks without any external study or input from experts (Main, 2018). From the critics' perspective, the underlying goals of the law are to allow utilities to spend excess earnings, avoid refunds, and choose new projects that prioritize their own interests (Main, 2018).

While the legislation certainly provides some concessions to Dominion, especially in terms of flexibility and interpretation, it still represents an opportunity to transform Virginia's renewable energy development. The success of this law is contingent upon effective implementation and diligent regulatory oversight.

MARKET BARRIERS FOR THIRD-PARTY RENEWABLE DEVELOPERS

Although Virginia's new policies create incentives for renewable development, these incentives primarily exist for Dominion and APCo. For example, the law allows the utilities to retain excess profits from consumers and reinvest these funds into renewable projects chosen at their discretion. The law also declares that large-scale, innovative projects for wind and solar power are in the public interest, but the only entities with the capacity to implement these projects at present are the major utilities. The legislation does not contain provisions that sufficiently support third-party developers of renewable energy technology.

In the absence of provisions to encourage third-party renewable development, these small developers still face significant market barriers. Third-party developers can include startups and entrepreneurs inventing new clean energy technologies, as well as small independent firms that design and/or install localized renewable energy installations. Typically, the independent firms are contracted by a customer to install a renewable project, such as solar panels, on the customer's property. The customer then pays for the use of the solar system, rather than for the power generated (Environmental Protection Agency, 2017).

For the purpose of this analysis, which focuses on expanding renewable energy development in Charlottesville, the relevant third-party developers are clean technology startups and entrepreneurs. As Virginia works to catch up with other leadership states in the renewable energy sector, it is critically important to encourage research, development, and commercialization of new clean technologies.

Even though the available technologies for wind and solar have become cheaper and more reliable, the need for new technologies does not disappear. By and large, the potential for harnessing renewable sources of energy remains untapped. Currently, renewable energy sources supply about 17 percent of total electricity generation in the United States (U.S. Energy Information Administration, 2017). The National Renewable Energy Laboratory predicts that renewable resources could effectively supply 80 percent of total electricity generation by 2050 using available and developing technologies. The report specifically notes the need for additional grid modernization technologies that improve interconnection between regions and integration of renewable energy (National Renewable Energy Lobby, 2012). In order to achieve these projections, new technologies must continue to enter the marketplace.

The three main market barriers for clean energy technology developers in Charlottesville are capital costs, market entry, and an unequal playing field (Union of Concerned Scientists, 2017). Each of these barriers are discussed in detail below.

Market Barrier: Capital Costs

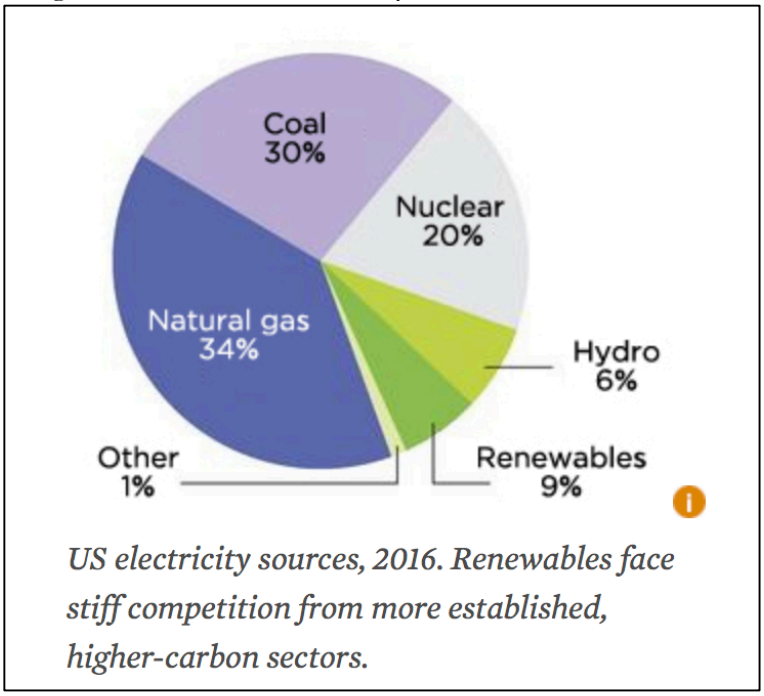
Although the costs of renewable energy technologies are decreasing on average, the startup and capital costs associated with renewable development remain high—especially for small businesses and entrepreneurs. Capital costs include the initial expenses of building and installing renewable projects (Union of Concerned Scientists, 2017). While incumbent utilities like Dominion and other large corporations have substantial resources for acquiring and building capital, the average engineer or scientist does not have this access.

Based on 2017 data, the average cost to develop a large-scale solar power system is roughly $2,000 per kilowatt. The cost of residential solar systems is about $3,700 per kilowatt (Union of Concerned Scientists, 2017). The average system size for households in the U.S. is six kilowatts, so the average cost to developers is $22,200 for a residential solar system (Matasci, 2018). In addition, wind power systems ranged from $1,200 to $1,700 per kilowatt (Union of Concerned Scientists, 2017). For small startups and entrepreneurs, these capital costs represent a significant market barrier to renewable development.

Market Barrier: Market Entry

The barrier to market entry for third-party developers in Charlottesville is two-fold: entering the energy market at large, and entering the existing market for renewable technologies. Historically, energy and electricity in the United States have been supplied by fossil fuels such as coal. More recently, nuclear and natural gas have also become major sources of electricity. These sources of energy are familiar, well-established, and supported by significant investment from traditional utilities. As a result, the technologies for extracting these resources hold tremendous market power (Union of Concerned Scientists). Figure 2 below shows the percentage of electricity derived from each major resource in the United States for 2016.

Figure 2: Sources of Electricity in the United States, 2016



Source: Union for Concerned Scientists, 2017

Due to the widespread nature of existing technologies, renewable energy technologies face a substantial barrier to market entry in the greater market for energy. Entrepreneurs and startups with new renewable technologies must compete with traditional energy industry giants; these industries have significant advantages in terms of existing policies, infrastructure, expertise, and funding (Union for Concerned Scientists, 2017).

In addition, third-party developers for renewables face a barrier to entry in the marketplace for existing renewable technologies. The costs of existing renewable technologies for solar and wind power continue to decrease, and these technologies have demonstrated their reliability. In order for new renewable technologies to successfully enter the market, developers must prove to investors that their products are innovative and have large-scale capacities (Union for Concerned Scientists, 2017).

The barrier to market entry is especially pronounced for renewable developers in Charlottesville, due to the outsized market share of Dominion and APCo. These two incumbent utilities control the vast majority of the statewide energy market, with Dominion alone serving 68 percent of Virginians (U.S. Energy Information Administration, 2016). Further, Virginia's new policies incentivize Dominion and APCo to invest in their own renewable projects, positioning startups in competition with the industry giants. Finally, Charlottesville already has a robust market for renewable energy technologies. Third-party developers with new technologies must compete with a cluster of renewable energy companies that collectively generate more than 2,700 megawatts of clean energy and drive the local market for renewable development (Strumlauf, 2017). Thus, the barriers to market entry present a considerable challenge for clean energy startups and entrepreneurs in Charlottesville.

Market Barrier: An Unequal Playing Field

The well-established industry giants, especially the fossil fuel industry, have utilized their extensive financial resources to gain substantial political influence over time (Union for Concerned Scientists, 2017). This political power has had two major effects. First, the fossil fuel industry receives billions of dollars in subsidies, tax breaks, and other incentives from the federal government. Estimates suggest that the United States spends $37.5 billion to subsidize fossil fuels each year (Union for Concerned Scientists, 2017). Second, the fossil fuel industry has leveraged its political power to circulate misleading information about climate change and discourage the uptake of renewable technologies. Some industry leaders, including ExxonMobil, Shell, and BP, even funded climate disinformation campaigns to undermine the science and confuse the public (Union for Concerned Scientists, 2017). These efforts create a major problem of incomplete and insufficient information among everyday consumers and voters. Ultimately, these campaigns successfully established climate change and renewable energy as partisan issues.

In addition to direct subsidies, the fossil fuel industry also incurs cost savings from the market prices of their goods. The prices consumers pay for oil, gas, and coal do not reflect the full costs associated with fossil fuels. For example, the environmental and public health costs of fossil fuel consumption are not accounted for in the prices of these commodities. In sum, allowing the fossil fuel industry to set their prices below the full costs of their goods acts as an indirect subsidy (Union for Concerned Scientists, 2017).

The political influence of the industry gives fossil fuel technologies an enormous advantage over the new renewable technologies developed by startups and entrepreneurs. Small start-ups must compete with massive industries that are highly subsidized both directly and indirectly by the federal government (Union for Concerned Scientists, 2017). This unequal playing field represents a major market barrier to third-party renewable developers.

This effect is magnified for clean technology startups and entrepreneurs in Charlottesville. These developers are overshadowed by the influence of the fossil fuel industry at the national level, and by the influence of Dominion at the state level. According to the Center for Responsive Politics, Dominion spent $1,450,000 in lobbying efforts for oil, gas, and electric utilities before the end of 2017 (Center for Responsive Politics, 2017). Average startups and entrepreneurs do not have the time, financial resources, or expertise to engage in lobbying efforts that would benefit their new renewable technologies. This emphasizes the market barrier effect of the unequal playing field in Charlottesville.

SURVEY OF RELEVANT LITERATURE

The literature offers insights into policies and programs that have assisted clean technology developers in overcoming market barriers. This review will also explore best practices associated with successful interventions.

Public-Private Partnerships

One study of common market failures and barriers associated with the renewable energy industry evaluates several clean energy policy interventions. The report identifies four policy categories that are often used to correct energy market failures and barriers: public-private research and development partnerships, voluntary information and technical assistance programs, regulatory policies, and investment-enabling fiscal policies (Brown, 2001). Since new regulatory and fiscal policies have just been established in Virginia, the other two categories are more relevant to the problem at hand. This section discusses the study's analysis of public-private partnerships, and the following section considers voluntary information programs.

First, this study discusses the effectiveness of public-private research and development partnerships. To examine this type of policy intervention, the study considers 11 public-private partnerships between the Department of Energy and private energy companies. These partnerships allowed the public and private entities to share financial resources, knowledge, time, and expertise. Based on data published by the Department of Energy, the study estimates that these partnerships produced energy efficient technologies that saved about 5050 trillion Btu of energy, or roughly $30 billion in energy costs, by the time of publication (Brown, 2001). The author offers a helpful comparison to guide the reader in conceptualizing these savings—the energy efficient technologies developed through this public-private partnership saved enough to meet the energy needs of all citizens and businesses in New York, Connecticut, and New Mexico combined for one year (Brown, 2001). Technologies that have emerged from the Department of Energy's partnerships include ozone-safe refrigerants, diesel engine technologies, and geothermal heat pumps (Brown, 2001). This study illustrates the success of public-private research and development partnerships in developing and commercializing energy efficient technology.

Information Programs

Next, this study considers how voluntary information programs can help reduce the market barrier of incomplete information in clean energy policy (Brown, 2001). Since insufficient information is a related aspect of the unequal playing field market barrier, this is relevant to the problem in Charlottesville. The author explains that consumers often lack sufficient or complete information about the renewable energy technologies available to them, because the public places a low priority on energy issues (Brown, 2001). Consumers do not prioritize energy issues because energy costs are typically low relative to other costs of living. As a result, most consumers do not spend time and energy gathering information about renewable energy options (Brown, 2001). The study suggests that information programs can mitigate incomplete information by reducing the consumer's cost of acquiring and understanding information about the renewable energy technologies available to them from local developers. Information programs also inform consumers about the cost savings associated with energy efficient technologies, which can increase local demand and lower market barriers to renewable development (Brown, 2001).

Clean Technology Incubation Programs

Similar interventions that have gained attention in recent years are clean technology incubation programs (Malek et al., 2014). While not all incubators are public-private partnerships, many programs acquire funding from both public and private sources. These programs model classic business incubation programs, which support startups and entrepreneurs by providing a physical workspace, industry expertise, a network of investors, and other resources. Clean technology incubators specifically offer resources for startups and entrepreneurs who develop and commercialize clean energy technologies (Malek et al., 2014). These programs often provide startups with access to the capital and investment opportunities necessary to bring their technologies to the marketplace.

The literature identifies key characteristics and best practices for successful incubators. A report from the Incubatenergy Network, a consortium of clean technology incubators across the country, compiles important data from its member incubator programs to evaluate the success of the network. The report also recognizes common best practices that lead to strong incubation programs (Incubatenergy Network, 2016).

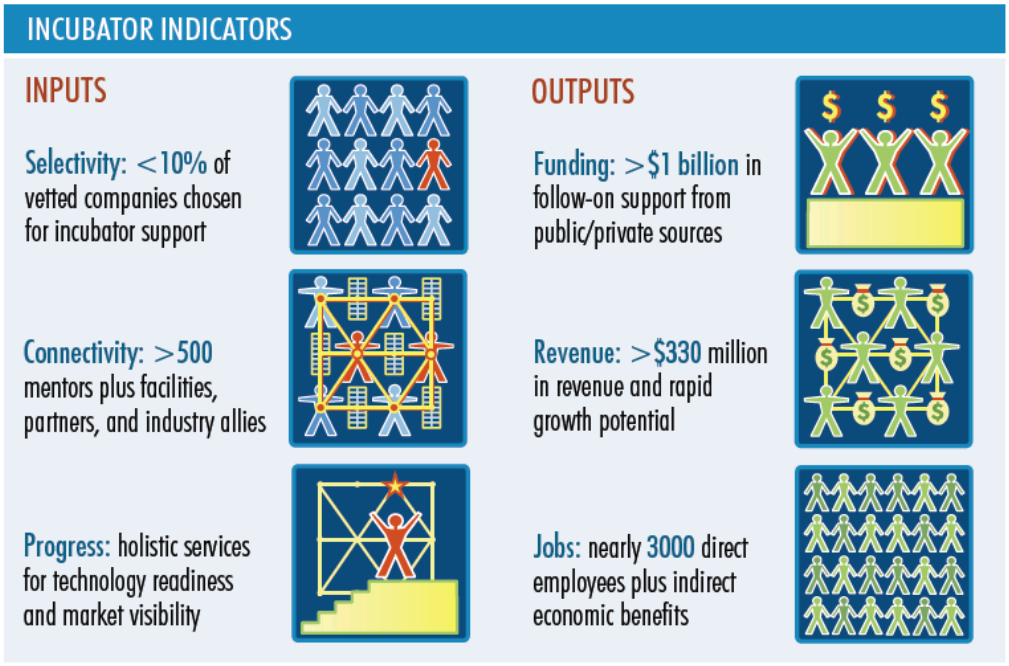
According to this report, there are several key characteristics of successful incubators. These programs:

- Exist at research universities or other research institutions
- Maintain access to manufacturing or product testing facilities
- Acquire funding from a combination of public and private entities
- Establish credibility with regional partners
- Connect with an available network of investors
- Consult with experts in the clean technology space
- Include a very selective admissions process
- Provide services including lab space, mentorship programs, legal and business counsel, hack-a-thons, and networking events
- Facilitate access to private venture capital, pilot customers, and joint ventures (Incubatenergy Network, 2016).

These characteristics suggest that strong incubation programs undergo a careful and strategic planning process before opening to the public. The location of the program, the climate of investment, and the opportunity to expand operations to manufacturing and testing facilities are important predictors of a successful program.

The Incubatenergy report also included a helpful graphic to demonstrate the accomplishments of incubator programs within the network. Figure 3 below displays this information.

Figure 3: Measures of Success for Incubators in Incubatenergy Network



Source: Incubatenergy Network, 2016.

In Figure 3, the inputs column highlights the top priorities for incubator programs within the Incubatenergy Network. These incubators focus on selective admissions, with less than ten percent of interested companies receiving admission to their programs. The individual incubator programs also value the connectivity of the larger network, which allows them to share mentors, facilities, partners, and knowledge. The incubator programs also prioritize their capacity to offer a comprehensive array of services, from physical workspace to market access.

The outputs column emphasizes the major accomplishments of this network of incubator programs. The network as a whole has received over $1 billion in funding from private and public sources, generated more than $330 million in revenue from commercialized technologies, and created 3000 jobs plus other economic benefits. The success of this vast network of individual clean technology incubators demonstrates the benefits of collaborating within and between incubator programs. The insights from this report can inform how a similar incubation program could help clean technology startups and entrepreneurs overcome market barriers in Charlottesville.

Mandatory Renewable Energy Portfolio Standard (RPS) Programs

The literature also suggests that mandatory RPS policies can lower market barriers for third-party renewable energy developers. In a report titled "Untapped Renewable Energy Potential: Lessons for Reforming Virginia's Renewable Energy Portfolio Standard from Texas and California," the author analyzes Virginia's current voluntary RPS policy. Virginia's voluntary RPS states that it is in the public interest for Dominion and APCo to derive 15 percent of total electric energy sales from renewable sources by 2025 compared to 2007 levels; however, the utilities are not required to meet this target (Allen, 2016).

First, the study explores the RPS as a policy tool. The author finds that the RPS is an effective policy for the medium-term for states that want to take small steps to incentivize renewable energy development. It can be successful because the RPS encourages in-state development at a low political cost. However, the author notes that RPS programs do not typically result in the economy-wide incentive effects that are created through carbon pricing mechanisms.

Next, the study compares Virginia to California and Texas, two other states with successfully implemented RPSs. The author finds that both California and Texas have created strong incentives to increase renewable energy development; in contrast, Virginia's policy falls far short. He recommends changing Virginia's current voluntary RPS to a mandatory RPS like California and Texas (Allen, 2016). Adopting a mandatory RPS can lower market barriers to all renewable technology developers, because the strong incentives drive statewide development, lower capital costs, and increase public awareness of energy efficiency goals (Allen, 2016).

POLICY ALTERNATIVES

Option 1: Establish a clean technology incubator in Charlottesville

This option involves acquiring a physical space and launching a business incubation program to support entrepreneurs who develop and commercialize clean energy technologies (Malek et al., 2014). Incubators provide local startups with lab space, mentorship opportunities, a network of investors, industry expertise, and opportunities to test and showcase their technologies (Office of Energy Efficiency and Renewable Energy, 2017). Bringing a clean technology incubator to Charlottesville could catalyze renewable energy development among third-party developers by creating opportunities for local entrepreneurs to invent and market clean technologies.

Many other cities and towns have successfully launched clean technology incubator programs and increased renewable development, as discussed in the Incubatenergy report. The Charlottesville Renewable Energy Alliance could seek guidance from this network of incubator programs during the process of establishing a local incubator. As noted above, key predictors of success include careful planning, sufficient resources, an investor network, and industry contacts. Charlottesville provides an ideal location for a clean technology incubator; the area is home to a concentration of highly educated individuals, an active community with demonstrated interest in renewable energy, and a network of wealthy investors.

A unique possibility exists in Charlottesville at present. A local company called Sp@ce has a stated mission of creating a new innovation district in Charlottesville. Over the past year, Sp@ce has been working closely with renowned local investor Jaffray Woodriff to develop plans for an innovation hub in Charlottesville. Their vision for an innovation hub is a multi-use office building with flexible space than can host local technology companies and foster a collaborative environment for entrepreneurs (Suarez, 2017). In 2017, the Main Street Arena located on Charlottesville's downtown mall was put on the market for commercial real estate. Woodriff purchased the 140,000-square-foot building for $5.7 million and intends to redevelop the space for the innovation hub (Suarez, 2017). The proposed name for the innovation hub is the Charlottesville Technology Center. According to the plans for the space, the innovation hub will need to identify an anchor tenant to oversee the innovation activities in the space. The anchor tenant will receive 60,000 square feet of the space; the remaining 80,000 square feet will be reserved for smaller tenants, lab space, and common areas (Suarez, 2017). The Charlottesville Energy Alliance could become the anchor tenant in the Charlottesville Technology Center and establish an incubator in this space. This opportunity presents a near-perfect environment for a new incubator program.

Option 2: Advocate for replacing the current voluntary RPS with a mandatory RPS

The literature suggests that states with a mandatory RPS program have created strong incentives for all renewable technology developers to increase development. A mandatory program holds states accountable for generating a certain level of electricity from renewable sources, which requires the continual development of renewable technologies. These programs have been proven to drive the market for renewable technologies, demonstrating success as an incentive system. In fact, roughly half of all growth in renewable energy generation and capacity in the U.S. since 2000 is associated with state RPS requirements (Barbose, 2017).

This option would involve advocating for new statewide policy at the General Assembly. The Charlottesville Renewable Energy Alliance could devise an advocacy strategy with its member organizations and other advocacy groups. The Alliance is uniquely prepared for this task, as its leadership has significant experience with renewable energy lobbying.

Further, this option would be low cost; the only expenses to the Charlottesville Renewable Energy Alliance would be those involved in the advocacy strategy. These costs would include time, travel to Richmond, and any marketing materials necessary. If the Alliance could successfully advocate for this policy change, the mandatory RPS would likely create the same incentives for Virginia that have been effective in other states. However, this option may be infeasible in the short-term, as the General Assembly will likely focus on other policy issues while Virginia's most recent energy policies take effect.

Option 3: Launch an information campaign to educate citizens about renewable options

At present, everyday citizens in Charlottesville and across the state lack complete and sufficient information about renewable energy options. The complicated nature of energy regulation, combined with the fact that most consumers do not prioritize energy issues, perpetuates the information problem. This is especially true in the face of Virginia's shifting political landscape. An information campaign could educate citizens about the new policies in Virginia and the renewable energy options that are currently available.

This option could also help level the playing field for clean technology entrepreneurs and startups in Charlottesville. If the local community has a better understanding of the benefits of renewable energy and energy efficiency, this may increase demand in the local market for new clean technology options. An information campaign could also highlight the reality of Dominion's influence in the Commonwealth. Armed with this information, Charlottesville citizens may be more likely to support local third-party developers. This could also encourage more clean technology startups to enter the market.

With this option, the Charlottesville Renewable Energy Alliance would incur limited expenses. The only costs would be those associated with developing an information campaign and the time spent disseminating the information. This option would also be feasible for the Charlottesville Renewable Energy Alliance. Part of the Alliance's stated mission is to support the Charlottesville community's transition to sustainable energy practices; an information campaign to educate citizens would help the Alliance achieve this goal.

Option 4: Let present trends continue

This option preserves the status quo. In this case, that means Virginia's new energy laws would drive renewable development from Dominion and APCo. Since the legislation was just signed into law on March 9, 2018, the trends for renewable development will change. The full impact of this law remains uncertain at present. However, the legislation does not sufficiently encourage third-party development, so the market barriers for clean technology startups and entrepreneurs would largely remain intact. This alternative would be feasible as it does not require change and protects the interests of Dominion and APCo. Also, there would be no costs associated with this option for the Charlottesville Renewable Energy Alliance.

EVALUATIVE CRITERIA

Each of the policy alternatives will be evaluated based on four criteria: cost-effectiveness, feasibility, sustainability, and efficiency. These criteria are described in detail below.

Cost

This criterion will measure the annual cost of each alternative to the Charlottesville Renewable Energy Alliance. The annual cost of each alternative will be estimated based on the costs of similar policies enacted in other localities.

Effectiveness

This criterion will assess how effective a policy alternative will be in reducing the identified market barriers to third-party renewable developers. The three major barriers are capital costs, market entry, and an unequal playing field. Each alternative will be evaluated based on the number of these market barriers it would address.

Feasibility

This criterion will measure the viability of each policy alternative. Specifically, this will measure the Charlottesville Renewable Energy Alliance's ability to successfully implement each alternative. Each alternative will be rated on a scale of low feasibility to high feasibility based on the Alliance's capacity to develop and implement the alternative.

Sustainability

This criterion will evaluate the long-term prospects of each policy alternative. Specifically, this will measure the ability of each option to maintain its beneficial effects on reducing market barriers for third-party developers into the future. In addition, this criterion will take into account whether or not each option will require continuous maintenance or funding from the Charlottesville Renewable Energy Alliance, as well as the Alliance's ability to provide this long-term support. Each alternative will be rated on a scale of low sustainability to high sustainability based on how effective the policy would be in the long term and the availability of long-term support.

CONSTRAINTS TO ANALYSIS

This analysis would be improved by a thorough cost-effectiveness analysis comparing the total costs of each alternative to the desired outcome of new third-party developers entering the market for renewable technologies in Charlottesville. The ideal metric for effectiveness would be the number of new developers entering the market as a result of each policy option. A cost-effectiveness analysis would determine the ratio of dollars spent per each new developer entering the market for each option. While it is possible to calculate a rough estimate of the number of new developers that would enter the market if an incubator was established in Charlottesville (Option 1), it is impossible to predict how many new developers would enter the market as a result of an information campaign or advocacy campaign to mandate the RPS (Options 2 and 3). This is due to a lack of available data on the impact of information and advocacy campaigns on renewable energy development. While some impact evaluations of public information campaigns exist, there are no studies measuring the effect of a renewable-energy-related information campaign on new renewable developers entering the market. Without this data, it is impossible to predict the number of third-party developers that would enter the market in Charlottesville.

More data exists about the outcomes associated with clean technology incubator programs. However, a common complaint among industry leaders is that there is no consistent mechanism for data collection or impact evaluation of incubator programs. Moreover, existing incubator programs vary widely in size and capacity. Thus, the data that exists regarding the number of clean technology startups successfully commercializing their products after incubation is specific to each program. This makes it difficult to generalize the impact of incubator programs on third-party development without major extrapolation.

In the absence of this data, the metric for effectiveness could not be set as the number of new developers entering the market for renewable technologies as a result of each option. Instead, the metric for effectiveness is the number of market barriers addressed by each option. Thus, the maximum ranking for an option's effectiveness is 3, indicating that the option addresses all three barriers. Since the costs of these alternatives are high, and the maximum unit for effectiveness is 3, a ratio of dollars per unit of effectiveness is largely unhelpful. For example, if an alternative's annual cost was 100,000 and it addressed 2 market barriers, the cost-effectiveness ratio would be 0.0002 dollars per market barrier addressed. This does not contribute to the larger analysis in a meaningful way.

EVALUATION OF POLICY ALTERNATIVES

Option 1: Establish a clean technology incubator in Charlottesville

Cost

This option involves the highest cost to the Charlottesville Renewable Energy Alliance. It is difficult to precisely estimate the annual costs of an incubator program, as data available from other programs reflects the varying costs of incubators with different capacities and sizes. This analysis aims to estimate annual costs based on data available from programs located in cities that are similar to Charlottesville in size.

In general, the annual costs associated with running incubator programs include rent for the physical space, investment funds to award to startups in the program, the cost of supplies and equipment for startups to use, the labor costs of staffing the incubator, and the cost of hosting events to showcase startups' achievements in the community. However, the Charlottesville Renewable Energy Alliance would not be responsible for all of these expenses. The literature suggests that the most successful incubators receive funding from a variety of sources, including public grants and private investments (Incubatenergy Network, 2016).

As discussed above, the innovation hub under development presents an ideal location for the Charlottesville Renewable Energy Alliance to establish an incubator. This space will be shared by other technology businesses and ventures, which would allow startups in the incubator to have direct contact with experts and investors. This would likely encourage nearby investors to cover the investment costs associated with the incubator program. There is no specific amount of investment required to run an incubator, but successfully established incubators can serve as models. The Venture Creations Clean Energy Incubator at the Rochester Institute of Technology in New York began their incubator with an investment fund of $3.5 million (Venture Creations, n.d.). Rochester and Charlottesville are similar in size and capacity, so this amount would likely provide sufficient funds to start an incubator in Charlottesville. The majority of these funds are allocated to startups who enter the incubator, which allows them to develop their technologies.

To estimate the annual costs of operating an incubator in Charlottesville, this analysis uses data from an *info*Dev report on financing incubators (2010). The report presents average annual expenses of 49 incubator programs (see Appendix A). The average annual costs of facilities, staff, IT infrastructures, marketing, administration, and other services amounts to $473,319 (*info*Dev, 2010). Based on this data, the Charlottesville Renewable Energy Alliance should assume that the annual costs of running an incubator would be about $500,000. However, the Alliance can defray these costs by acquiring funds from investors and public grants.

Effectiveness

An incubator program would address all three market barriers to third-party renewable developers. First, capital costs would be significantly reduced through the incubator program by providing startups and entrepreneurs with funding from investors and lab space. An incubator program would also address the barrier of market entry. By definition, clean technology incubators exist to provide resources that help startups and entrepreneurs develop technologies and bring them to the marketplace. The incubators in the Incubatenergy Network have helped over 350 startups and

entrepreneurs enter the marketplace for renewable technologies (Incubatenergy, 2016). This demonstrates the success of these programs in addressing the barrier of market entry.

Finally, an incubator program would help level the playing field for third-party renewable developers. The Charlottesville Technology Center development will likely receive high-profile attention upon completion. It will also be an open-concept building located on the Downtown Mall, which generates significant foot traffic every day. By positioning itself in the midst of the community, the innovation hub will spark conversation and interest from everyday citizens. If the incubator is located within the Charlottesville Technology Center, this would create an opportunity to circulate information about new renewable technology options available to consumers. Additionally, the incubator would provide third-party developers with resources and connections that they otherwise would not have; this network would help new renewable developers facing competition from Dominion and APCo. This alternative represents the most effective option for reducing market barriers.

Feasibility

This option is highly feasible for the Charlottesville Renewable Energy Alliance, especially due to the opportunity presented by the innovation hub development. The Alliance, which is comprised of eight renewable energy member companies, has the industry expertise and investor connections necessary to run an incubator program. Further, the Charlottesville Technology Center would provide an ideal environment to establish a successful incubator. The incubator would be in close proximity to the University of Virginia, a large research institution, and it would have established connections to the surrounding network of other technology businesses and investors. The main responsibilities of the Charlottesville Renewable Energy Alliance would include overseeing the incubator program, offering mentorship opportunities, attracting continual investment, and facilitating connections between participating startups and investors. The Alliance has the capacity to implement this option, and it would advance their mission to establish Charlottesville as a hub for renewable energy.

Sustainability

Once implemented, this option would be sustainable in the long-term. A successfully established incubator would continue to lower market barriers for third-party renewable technology developers far into the future. However, this option requires continuous involvement from the Charlottesville Renewable Energy Alliance. The Alliance would need to run the incubator and constantly secure funding sources; however, the Alliance has the capacity and expressed desire to do this.

This option has medium sustainability. Although it would be the most sustainable way to continually reduce market barriers into the future, it also requires the most continual funding and oversight.

Option 2: Advocate for replacing the current voluntary RPS with a mandatory RPS

Cost

This alternative is a relatively low cost option for the Charlottesville Renewable Energy Alliance. The only annual costs to the Alliance would be those associated with developing and implementing an advocacy campaign to convince the General Assembly that a mandatory RPS would encourage

third-party renewable development in Virginia. As part of an advocacy campaign, the Charlottesville Renewable Energy Alliance would need to develop a strategic plan, conduct research, formulate and print informative issue briefs, build a coalition with other organizations, and travel to Richmond to convince legislators to mandate the RPS.

This option does not require significant financial investment from the Charlottesville Renewable Energy Alliance. Instead, the major cost would be the time spent by employees developing and implementing the advocacy strategy. Another cost would be the travel costs associated with trips to the General Assembly. To estimate the cost of employees' time, this analysis uses the average salary of a Government and Regulatory Affairs Manager at Apex Clean Energy, a member organization of the Alliance. The analysis also uses a sample budget for an advocacy campaign to estimate the amount of time and resources required (The Retirement Research Foundation, n.d.).

The average salary for a Government and Regulatory Affairs position at Apex is $102,500 (Glassdoor, n.d.). If three staff members dedicated 25 percent of their time over the course of one year to leading and implementing an advocacy campaign, this would cost $76,875. The remaining costs of travel are estimated assuming 20 miles per gallon, current gas prices at $2.50 per gallon, and the 70-mile distance between Charlottesville and Richmond. The estimated travel cost of five trips to Richmond is $88. Thus, the estimated total annual cost of this option is $76,963.

Effectiveness

This option would address two of the market barriers to third-party renewable developers—the unequal playing field and market entry. At present, the outsized influence of Dominion is perpetuated in the General Assembly through the corporation's extensive lobbying efforts. This creates an unequal playing field for third-party renewable developers, because the policies that are passed largely represent the interests of the established utilities. This option enables the Charlottesville Renewable Energy Alliance to promote the interests of small startups and entrepreneurs who otherwise would not have the capacity to influence the General Assembly. The advocacy campaign would help level the playing field by using the Alliance's resources to launch opposition to Dominion.

If the advocacy campaign successfully convinced the General Assembly to mandate the RPS, this would also reduce the market barrier to entry for third-party developers. Mandatory RPS policies have been proven to catalyze statewide renewable development through strict requirements that encourage new technologies to continually enter the market (Allen, 2016). The increased demand for new technologies reduces the barrier to market entry for third-party developers who can supply these technologies.

Feasibility

This option represents medium feasibility for the Charlottesville Renewable Energy Alliance. On one hand, the Alliance has the capacity to develop an advocacy campaign and meet with legislators. The Alliance's leadership is equipped with significant experience in renewable energy lobbying, so the advocacy campaign is highly feasible in terms of development and execution. However, this option has limited feasibility in terms of implementation. Since the 2018 Session of the General Assembly had a major focus on renewable energy issues that resulted in sweeping policy changes, it is unlikely that legislators will pass further legislation in the immediate future. The General Assembly

will most likely focus on other policy areas while the new energy legislation takes effect across the Commonwealth. Taking both measures of feasibility into account, this option has medium feasibility.

Sustainability

This option has low sustainability in the long-term. As discussed above, the advocacy campaign has limited feasibility in terms of successfully convincing the General Assembly to mandate the RPS in the immediate future. Thus, the Charlottesville Renewable Energy Alliance would have to continue this advocacy campaign for several years in order to achieve the desired policy. While the Alliance has the capacity to develop a campaign, it may not have the resources to maintain this specific campaign over a long period of time. The employees responsible for leading the campaign may need to dedicate their time to future projects with a higher impact.

Further, the sustainability of the alternative refers to the option's ability to reduce market barriers into the future. If the advocacy campaign does not result in the implementation of the mandatory RPS policy, then this option would not effectively reduce the market barrier to entry in the long term. Also, if the Charlottesville Renewable Energy Alliance is unable to continue the advocacy campaign for multiple years, it would not have long term effects on the unequal playing field market barrier. This option would only be sustainable if the advocacy campaign successfully changed the RPS policy in the near future, which is unlikely.

Option 3: Launch an information campaign to educate citizens about renewable options

Cost

The annual costs of an information campaign to the Charlottesville Renewable Energy Alliance are estimated using a toolkit from a public education campaign in Massachusetts (Blue Cross Blue Shield of Massachusetts Foundation, 2011). This campaign was a statewide effort to help citizens understand the health policy changes of the Affordable Care Act. The costs associated with this campaign included assembling a team of experts, conducting market research, building a coalition of partner organizations, and developing a key narrative, and disseminating information through brochures, flyers, posters, television ads, radio ads, newspaper ads, social media and community events. In total, the Massachusetts campaign spent $7.2 million over five years (Blue Cross Blue Shield of Massachusetts Foundation, 2011).

This analysis estimates the cost of a similar information campaign in Charlottesville by scaling the Massachusetts campaign's budget to the population of Charlottesville. Since the audience for Massachusetts campaign was the entire state, with a population of 6.86 million people, this represents a much larger outreach effort. The population of Charlottesville is approximately 50,000; thus, the estimated cost of a five-year campaign serving this population is $52,478. The estimated annual cost to the Charlottesville Renewable Energy Alliance for this option is $10,495.

Effectiveness

This option would only address the unequal playing field market barrier; however, it is a highly effective strategy for reducing this barrier. The literature suggests that everyday citizens lack sufficient information about renewable energy issues; this is partially due to the low cost of

consumers' current energy supply relative to other life expenses and the difficulty associated with understanding the complex energy industry (Brown, 2001). The problem is also perpetuated by disinformation campaigns from fossil fuel industry that undermine renewable energy efforts (Union of Concerned Scientists, 2017). Thus, traditional utilities have a significant advantage over third-party renewable developers because of their influence and familiarity among consumers.

An information campaign could successfully educate everyday citizens on the benefits of energy efficiency and renewable energy, the reality of Dominion's influence in the Commonwealth, and the renewable technology options available to consumers. This approach has been proven to mitigate the information problem associated with the unequal playing field market barrier, because it reduces consumers' costs of gathering and understanding information about renewable energy issues (Brown, 2001). Thus, the Charlottesville Renewable Energy Alliance could effectively address this barrier for third-party developers in Charlottesville by educating the community through an information campaign.

Feasibility

This option has high feasibility. The Charlottesville Renewable Energy Alliance has the capacity to develop and implement an effective information campaign. The member organizations of the Alliance have the technical expertise necessary to compile factual information about renewable energy issues and present data in an effective manner. The Alliance understands the renewable energy options currently available and can connect interested consumers with developers who offer residential services. In addition, the Alliance can adequately address consumers' questions and concerns about renewable energy technologies or the industry at large.

In addition to the Alliance's ability to provide sufficient, factual information, it also has the capacity to implement an information campaign. The Alliance has the resources necessary to print and disseminate flyers and brochures, host community outreach events, and utilize available media. This option is also highly feasible because it would advance the Alliance's mission of assisting the Charlottesville community's transition to sustainable energy practices.

Sustainability

This option has limited sustainability in terms of addressing market barriers into the future. While an information campaign would improve consumers' knowledge and start to level the playing field for third-party renewable developers, it would not address capital costs or market entry. Also, the Charlottesville Renewable Energy Alliance cannot support this campaign indefinitely; it would eventually need to dedicate resources to other future projects. The information campaign would be a short-term intervention with low sustainability.

Option 4: Let present trends continue

Cost

With this option, the Charlottesville Renewable Energy Alliance would not incur any annual costs. By letting present trends continue, the Alliance would allow the Commonwealth's new energy legislation to take effect without any additional intervention to support clean technology startups and entrepreneurs.

Effectiveness

The policy problem at hand is a result of present trends; third-party renewable developers currently face barriers including capital costs, market entry, and an unequal playing field in the marketplace for renewable technologies. Allowing present trends to continue would not address any of these barriers. Thus, this option is not effective.

Feasibility

This option has medium feasibility. Allowing present trends to continue does not require any action from the Charlottesville Renewable Energy Alliance. This would allow the Alliance to focus on other goals unrelated to encouraging innovation from clean technology startups and entrepreneurs in Charlottesville. However, since supporting third-party development is an important objective for the Alliance, this option is unattractive. While inaction is a viable option, it is also unlikely. For this reason, this option has medium feasibility.

Sustainability

The status quo option involves allowing Virginia's new energy policies to take effect without any additional intervention to support clean technology startups and entrepreneurs. This option does nothing to address the market barriers for third-party developers at present or in the future. Therefore, this option has low sustainability because the market barriers would remain intact in the long term.

OUTCOMES MATRIX

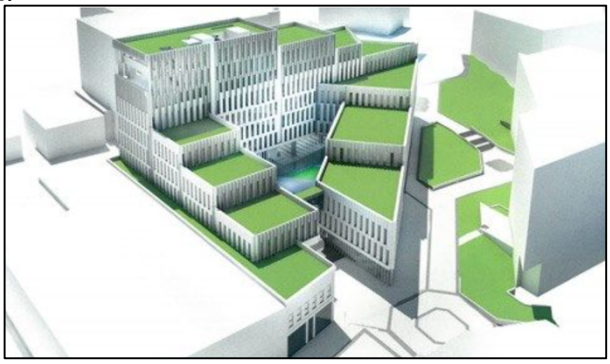
	Status Quo	Clean Tech Incubator	Advocate for Mandatory RPS	Launch information campaign
Cost	$0	$500,000	$76,875	$10,495
Effectiveness (number of market barriers reduced)	0	3	2	1
Feasibility	Medium	High	Medium	High
Sustainability	Low	Medium	Low	Low

RECOMMENDATION AND IMPLEMENTATION

It is recommended that the Charlottesville Renewable Energy Alliance works to establish a clean technology incubator in Charlottesville's developing innovation district. Although this option involves the highest annual costs to the Alliance, it also represents the most effective and sustainable option for reducing the barriers of capital costs, market entry, and an unequal playing field for third-party developers. Establishing an incubator is also highly feasible given the opportunity presented by the Charlottesville Technology Center developing on the Downtown Mall.

In order to effectively implement this option, the Charlottesville Renewable Energy Alliance should begin with a careful strategic planning process. As part of this process, the Alliance will need to secure a physical space in the innovation hub; ideally, the Alliance would become the anchor tenant and run the incubator in the 60,000-square-foot space allocated for the lead organization. The planning process will also require negotiating the rent, acquiring capital from investors, creating a fund for investment in participating startups, applying for public grants, determining an application and selection process for startups, and establishing additional connections with experts and investors. Since construction of the Charlottesville Technology Center will begin in the summer of 2018 and is expected to continue for at least a year, the Alliance should focus on the planning process in the interim. Figures 4 and 5 below display the designs for the innovation hub.

Figures 4 and 5: Plans for Charlottesville Technology Center



Source: Suarez, 2017.

Once the physical space is available and the strategic planning process is complete, the Charlottesville Renewable Energy Alliance can open the incubator and begin operations. Based on the incubator's close proximity to the University of Virginia, the availability of a robust investor network, the shared space with experts and other innovators, and the established credibility of the Alliance's member organizations, the incubator will likely foster innovation and renewable technology development among startups and entrepreneurs. This opportunity will allow the Charlottesville Renewable Energy Alliance to make major strides toward its mission of positioning Charlottesville as a hub for renewable energy.

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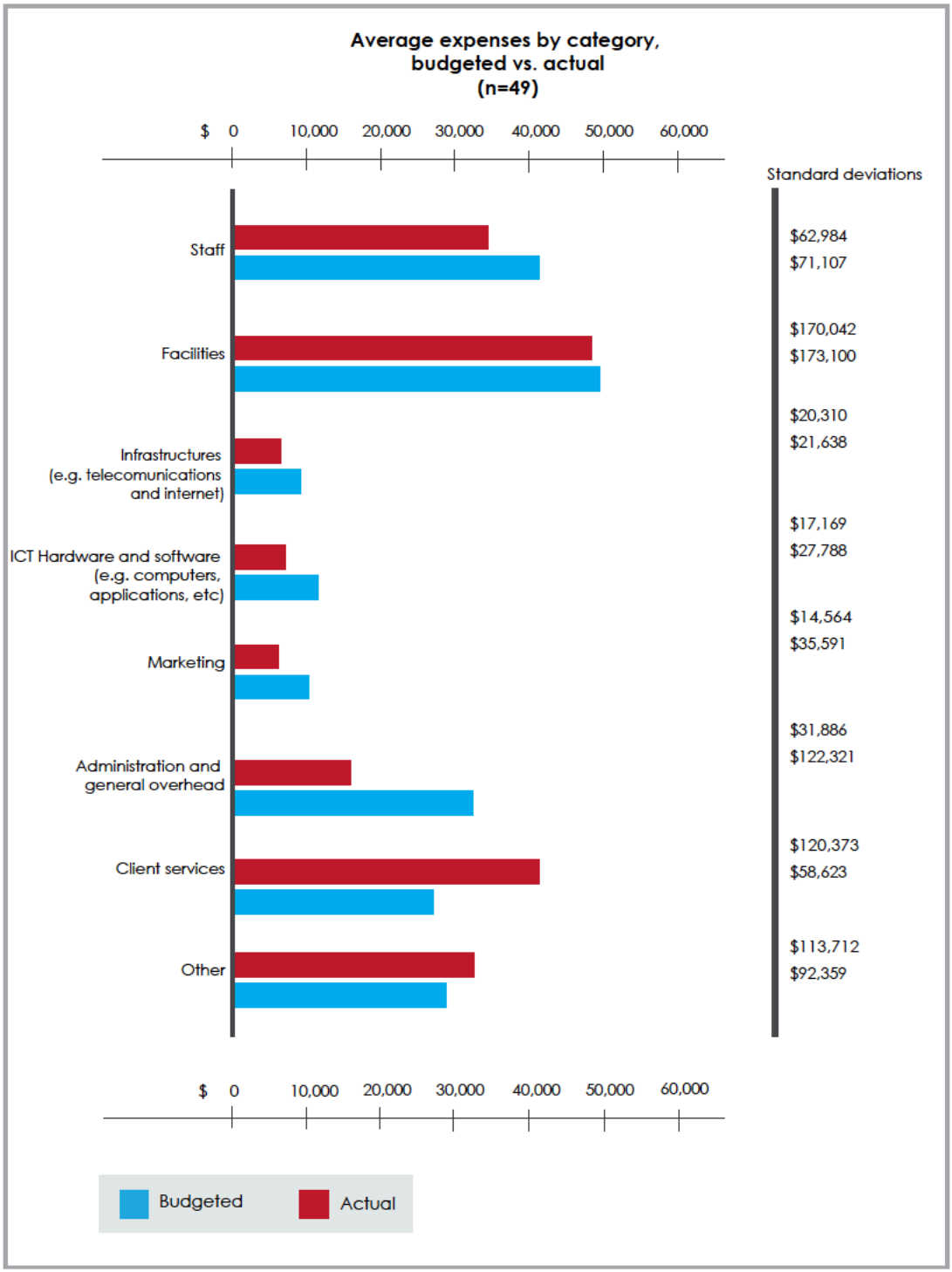
APPENDIX A


Average expenses by category, budgeted vs. actual (n=49)
$ 0
10,000
20,000
30,000
40,000
50,000
60,000
Standard deviations
Staff
$62,984
$71,107
Facilities
$170,042
$173,100
Infrastructures (e.g. telecomunications and internet)
$20,310
$21,638
ICT Hardware and software (e.g. computers, applications, etc)
$17,169
$27,788
Marketing
$14,564
$35,591
Administration and general overhead
$31,886
$122,321
Client services
$120,373
$58,623
Other
$113,712
$92,359
Budgeted
Actual

HONOR PLEDGE

I pledge that I have neither given nor received help on this assignment beyond that specific in the class syllabus.