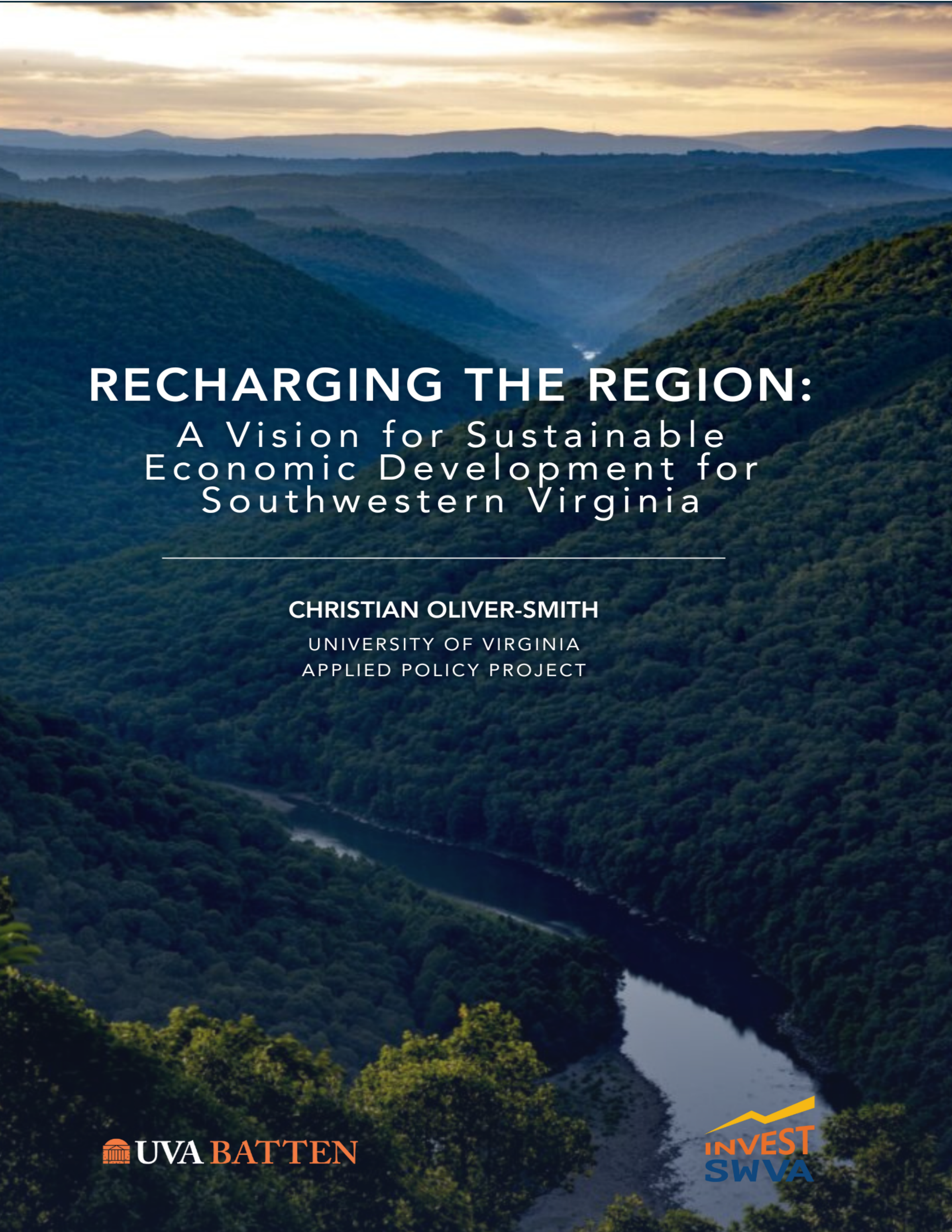

RECHARGING THE REGION:
A Vision for Sustainable Economic Development for Southwestern Virginia

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UNIVERSITY OF VIRGINIA
APPLIED POLICY PROJECT

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INVEST SWVA

Acknowledgements

This project stands as a beacon of my academic and personal journey, a journey that would not have been possible without the support, guidance, and encouragement of many. At the forefront, I extend my deepest gratitude to Professor Volden, my advisor during the second semester, whose insights and direction have been invaluable. His patience and expertise helped refine my ideas into the work you see today. I am equally grateful to Professor Pennock, my first-semester APP advisor. Professor Pennock played a pivotal role in getting this project off the ground. His encouragement and foundational guidance set the trajectory for this research, for which I am deeply thankful. Special thanks are due to Professor Bill Shobe, whose expertise in renewable energy and its benefits has been a cornerstone of this work. His guidance illuminated the complexities of the field and enriched my understanding and appreciation for the subject matter.

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Disclaimer

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UNIVERSITY of VIRGINIA HONOR CODE

On my honor as a University of Virginia student, I have neither given nor received unauthorized aid on this document.

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Definitions and Acronyms

Appalachian Region: The Appalachian region includes 13 states including: Alabama, Georgia, Kentucky, Maryland, Mississippi, New York, North Carolina, Ohio, Pennsylvania, South Carolina, Tennessee, Virginia, and West Virginia.
Central Appalachia: The Central Appalachia delineation falls within six states: Georgia, Kentucky, North Carolina, Tennessee, Southwest Virginia, and West Virginia
Earnings – Refers to wage and salary paid to workers and benefits.
GO Virginia Regions: Nine regions defined by the Department of Housing and Community Development throughout the commonwealth of Virginia.
GO Virginia 1 Region: Region One includes the counties of Bland, Buchanan, Carroll, Dickenson, Grayson, Lee, Russell, Scott, Smyth, Tazewell, Washington, Wise, and Wythe, and the cities of Bristol, Galax, and Norton.
Optimal Community Scale Assessment (OCSA): A project-specific criterion that measures the size of the project and whether it is too big or too small to have positive impact on the community.
Output – The economy activity or value of production activity to the state or local economy.
Southwest Virginia: Southwest Virginia includes the cities: Bristol, Galax, and Norton and the commonwealth counties: Bland, Buchanan, Carroll, Dickenson, Grayson, Lee, Russell, Scott, Smyth, Tazewell, Washington, Wise, and Wythe
Value Added – The difference of total gross outputs and the cost of intermediate inputs.
ACC - Assistants to Coal Community Initiative
ARC – Appalachian Regional Commission
AFID – Agriculture & Forestry Industries Development Fund
EDA – U.S Economic Development Administration
EPA – Environmental Protection Agency
ITC – Investment Tax Credit
PTC – Production Tax Credit
PV – Photovoltaic
SWVA – Southwest Virginia
VCEA – Virginia Clean Economy Act

Executive Summary

As the national and Virginia economies pivot away from coal, Southwest Virginia faces continued economic challenges. The decline in coal production and usage threatens the region with increased poverty, reduced life expectancy, and the loss of its younger population to out-migration in search of better job opportunities. However, the shift towards clean and renewable energy, coupled with growing energy demands in Virginia, presents a unique chance for economic rejuvenation in Southwest Virginia. This report examines Southwest Virginia's potential to leverage its rich history in energy production and its diverse landscape to jumpstart sustainable economic growth through clean energy initiatives. We explore three renewable energy projects designed to usher in a new era of economic vitality:

1. A 300 MW Utility Solar Farm on Abandoned Mine Lands.
2. A 225 MW Utility Wind Farm.
3. A Soybean Biodiesel Production Plant.

These projects were evaluated on the basis of cost, economic impact, equity, and political feasibility.

After a thorough assessment of these criteria and the trade-offs involved, this paper recommends the implementation of **a 300 MW Utility Solar Farm on abandoned mine** lands as the optimal choice for stimulating economic development in Southwest Virginia. This alternative stands out across all evaluation criteria, offering the most promising pathway for the region's economic revitalization.

Introduction

In the heart of Appalachia, the Southwest Virginia region stands on the brink of a transformative era. Historically anchored to the coal industry, the area now faces the imperative of navigating a pivotal transition towards sustainable economic vitality. This report, "Recharging the Region: A Vision for Sustainable Economic Development in Southwest Virginia," presents a comprehensive analysis aimed at propelling the region into a future fueled by clean and renewable energy.

Crafted with a deep understanding of the region's unique challenges and opportunities, this document serves as a roadmap for revitalizing Southwest Virginia's economy through the strategic implementation of renewable energy projects. It is a synthesis of rigorous research, analysis, and stakeholder engagement, aimed at offering actionable insights and recommendations to steer the region towards economic diversification and sustainability.

At the core of this vision lies a commitment to not just alter the energy landscape but to fundamentally enrich the lives of the residents of Southwest Virginia. By leveraging the potential of renewable energy, this report seeks to ignite a cycle of job creation, educational opportunities, and community development, marking a departure from the legacy of coal towards a resilient and prosperous future.

This document is structured to guide policymakers, stakeholders, and community members through a detailed exploration of the current economic context, the promise of renewable energy, and the strategic steps necessary for successful implementation. From the problem statement to the recommendations and conclusion, each section builds upon the last to present a cohesive and comprehensive strategy for economic revitalization.

As we embark on this journey of transformation, it is with a sense of optimism and responsibility. The challenges are significant, but so are the opportunities. Through collaboration, innovation, and a shared vision, Southwest Virginia can emerge as a model of sustainable development, resilience, and economic prosperity.

Problem Statement

The economic sustainability of Southwest Virginia is in dire jeopardy as the region grapples with the severe repercussions of its historical dependence on coal mining at a time when the United States is actively moving away from fossil fuels toward green energy. In 2022, the annual mean wage in Southwest Virginia per capita, was roughly $20,000 less than the national average (U.S. Bureau of Labor Statistics, 2022). The region's historical reliance on coal extraction, combined with an evolving energy landscape that increasingly emphasizes green technologies, has led to a persistent and debilitating erosion of its economic ecosystem. As the U.S. seizes opportunities in the green energy sector, Southwest Virginia faces the challenge of adapting to this shift. **The region's failure to systematically capitalize on emerging opportunities in clean and renewable energy has left it with a substantial economic gap, reflecting both an inability to seize these prospects and a persistent failure to do so. This economic shortfall is not only a consequence of the declining coal industry but also indicative of a broader failure to align with the changing national energy narrative.**

Client Overview

Invest Southwest Virginia (SWVA) is a dynamic and influential business attraction firm serving as a crucial intermediary between public and private interests in Southwest Virginia. Invest SWVA's mission is to catalyze economic development by harnessing political relationships, cultivating high-quality business leads, and forging new strategic partnerships. At the core of their endeavors lie a commitment to propel the economic vitality of the region. SWVA has requested an exploration and assessment of renewable energy projects that not only contribute to offsetting Virginia's escalating energy demand but also possess the potential to stimulate increased economic activity and prosperity within the GoVA-1 region[1]. Recognizing the pivotal role of green energy in shaping the future, their focus is on identifying sustainable solutions that align with the evolving national energy landscape.

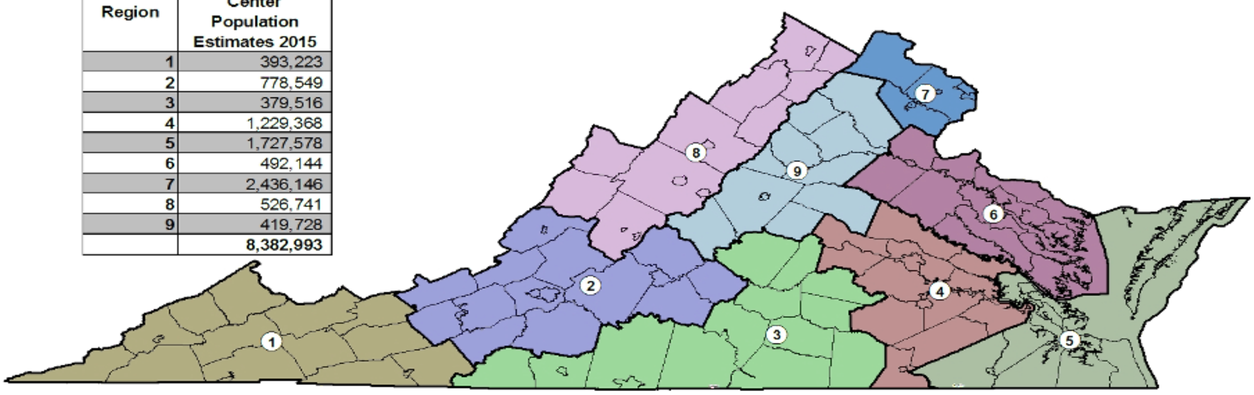
Invest SWVAs' objective is to identify the optimal energy project that will catalyze economic activity and enable the region to effectively leverage the burgeoning opportunities in renewable energy. As the national energy landscape undergoes a transformative shift away from coal, Southwest Virginia is grappling with both energy and economic discontinuity. This analysis aims to provide a nuanced understanding of these challenges and, critically, to propose sustainable solutions that align with the evolving market dynamics. The significance of this evaluation extends beyond immediate gains; it is positioned to benefit multiple stakeholders. By

[1] **Virginia Department of Housing and Communi**

Figure 1. Go Virginia One Regions

strategically selecting and implementing large-scale renewable energy projects, Invest SWVA anticipates a substantial economic upswing that permeates through local communities, businesses, and governmental entities. SWVA deserves projects where economic impacts are enduring and foster sustained growth and prosperity.

Region	Weldon Cooper Center Population Estimates 2015
1	393,223
2	778,549
3	379,516
4	1,229,368
5	1,727,578
6	492,144
7	2,436,146
8	526,741
9	419,728
	8,382,993



Background

Southwest Virginia's coalfield regions are in a dire predicament stemming from a multifaceted decline in coal production, driven by the national shift away from coal towards renewable and clean energy sources. The coal industry, both within Appalachia and the broader United States, has experienced a profound downturn over the last decade, with demand plummeting across the nation(Carley et al., 2018). The compounding impact of the COVID-19 pandemic and the associated economic recession has further exacerbated the challenges faced by the already troubled coal production sector.

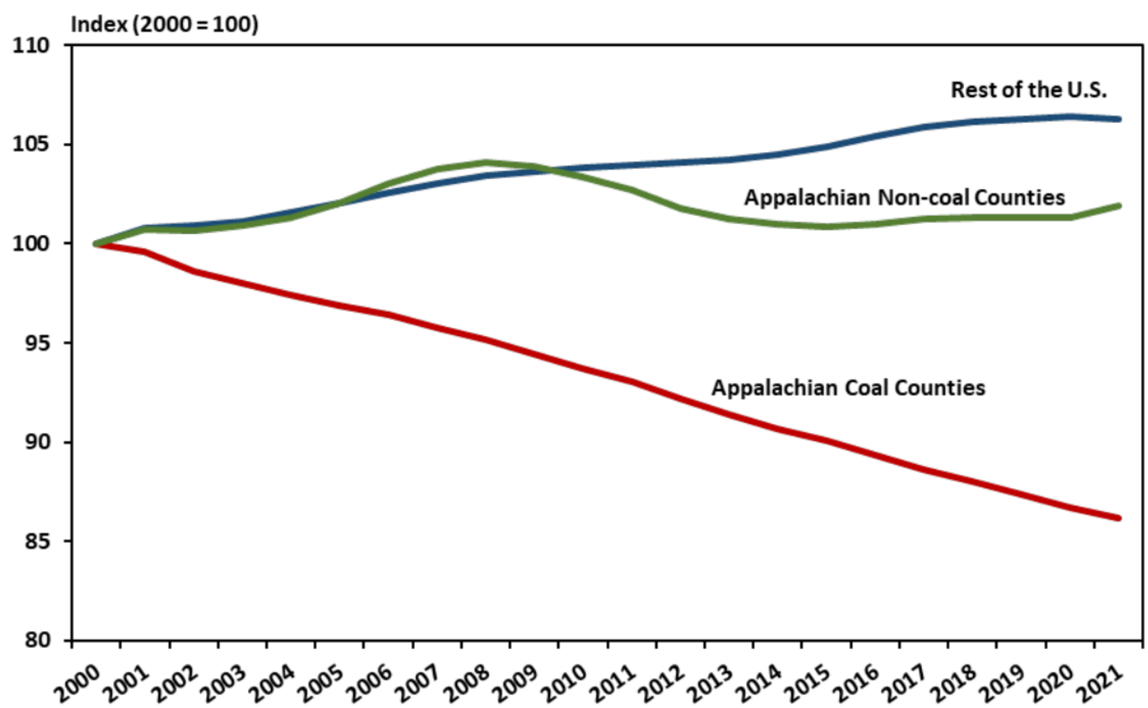
Historically, Southwest Virginia (SWVA) has been subject to underinvestment, marked by the extraction of resources from the region without commensurate reinvestment into local communities and their economies. This chronic lack of investment has impeded the development of alternative industries, leaving the region heavily reliant on coal and fossil fuels. This extractive nature is mirrored in an underdeveloped education system and job training infrastructure, perpetuating a cycle of economic dependence(Hernandez, 2023).

However, this detriment has not affected all communities equally. Central Appalachia, when compared across the board to Southern and Northern Appalachia, as well as the United States as a whole, has borne the brunt of the impact from the shift away from coal. The concentrated losses in coal production within the Central Appalachia coal-producing subregion, of which Southwest Virginia is an integral part, can be attributed to low coal mine worker productivity. A century of aggressive mining has rendered the remaining coal more challenging and costly to extract, given its deeper location and thinner seams compared to other coal subregions. As coal employment in Appalachia plummeted by 62%, a sharper decline than the nearly 43% observed in the rest of the United States, the repercussions were felt acutely in Southwest Virginia(*Coal Production and Employment in Appalachia, Summer 2023*, n.d.-a).

The region's economic ecosystem has been rendered dysfunctional, characterized by a scarcity of entrepreneurship and a scarcity of jobs unrelated to coal. The resistance to change is deeply ingrained, stemming from both cultural and economic attachments to coal, fueled by the perceived economic benefits derived from the industry(Morris et al., n.d.). Despite historically enjoying higher wages and salaries than non-coal communities, Southwest Virginia now faces the ominous prospect of falling further behind. As Appalachian coal mining and affiliated industries face closures, the average wage and salary of coal communities are projected to decline, exacerbating economic challenges.

Southwest Virginia's reliance on coal has not only resulted in a poor economic ecosystem but has also led to an increasing percentage of its population living below the US poverty line, with a median income of $37,663—significantly lower than the state average of $63,636(*Virginia's Regional Profiles*, n.d.). Furthermore, increased outmigration from coal-centric communities in Southwest Virginia, particularly among the prime working-age population (ages 24-54), is a major issue. As seen in figure 2 the prime working-age population has experienced a decline exceeding 14%, in stark contrast to the overall 2% population decline in the region in the last decade(*Coal Production and Employment in Appalachia, Summer 2023*, n.d.-b).

Figure 2. Population 25-54 Years Old, Appalachian Coal



This graph shows the decline in the working age population in Appalachian Coal counties compared to non-coal counties in Appalachia and the broader United States

The ramifications extend beyond mere economic challenges, revealing a glaring educational disparity. While 35.8% of the national population holds a bachelor's degree or higher, Central Appalachia lags significantly behind at 18.1% as of 2022. This widening gap in educational attainment poses a considerable social capacity challenge, further complicating the region's ability to adapt to a shifting economic landscape. The low educational attainment, deeply rooted in the coal-centric culture, has left Southwest Virginia in dire straits, exacerbating the divide between the region and the rest of the United States(*ALICE; United Way of Southwest Virginia; Call 211*, n.d.). This paints a stark picture of a region grappling not only with economic decline but also confronting social, cultural, and demographic challenges as it endeavors to navigate a transition away from its historical dependence on coal.

Renewable Energy Shift in Virginia

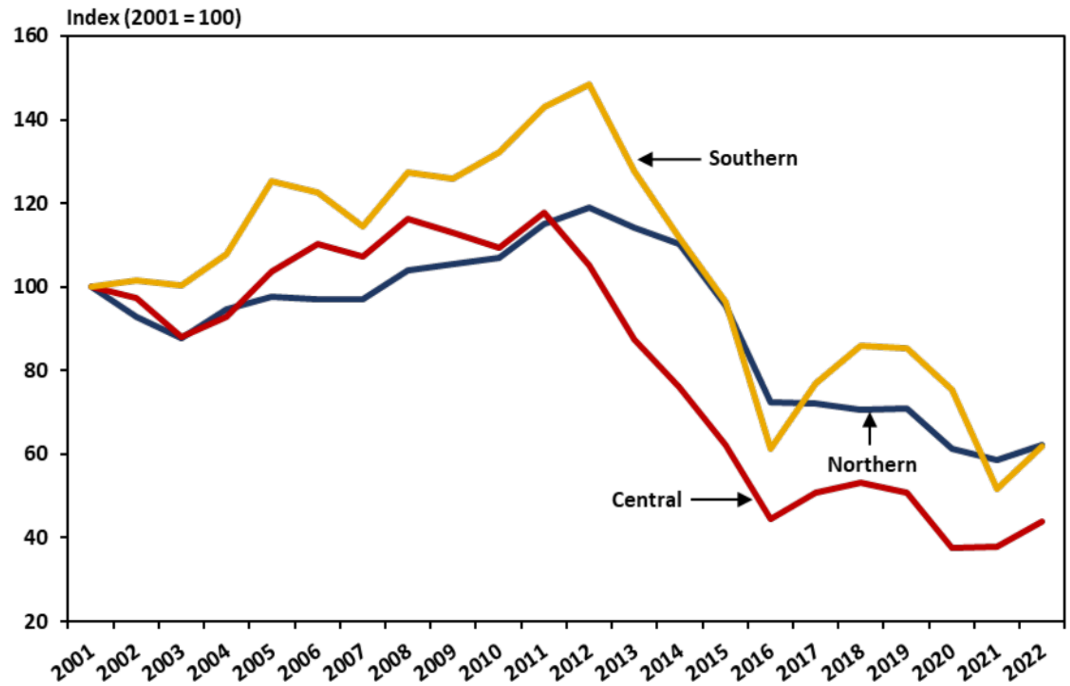
Virginia, through the "Virginia Clean Economy Act"(VCEA) of 2020, has charted an ambitious course for its energy future. The state aims to revolutionize its energy grid, currently dominated by duopoly providers Dominion Energy and Appalachian Power, with a commitment to achieving 100% renewable energy production by 2045 and 2050, respectively(*Renewable Energy | Virginia DEQ*, n.d.). However, the transition to renewable energy in Southwest Virginia has been sluggish for several reasons. The region's profound ties to coal mining and processing, deeply rooted in its cultural identity, have posed a formidable challenge to embracing change. Furthermore, the lack of substantial investment in rural areas by the state of Virginia, combined with the absence of designated state agency infrastructure and carve-outs for rural funding, distinguishes the region's struggle(Roemer & Haggerty, 2021).

The designation of Southwest Virginia as a coal community opens the door to federal funds and subsidies for various renewable energy initiatives, particularly in coal and wind projects. Given its challenging educational and economic conditions, the region is well-positioned to qualify for additional federal tax breaks and incentives. Despite facing obstacles in expanding to larger scale utility projects, Southwest Virginia has embraced community solar projects under the VCEA program.

The geographical landscape of Southwest Virginia presents valuable opportunities for energy projects. Abandoned coal mines, expansive forestry areas, and high altitudes make the region's real estate ideal for such endeavors. These unique characteristics not only support ongoing initiatives but also enhance the potential for unlocking additional federal grants and tax incentives, beyond state and local.

Southwest Virginia stands at a crossroads, facing a future where the cascading effects of economic decline could profoundly deepen without intervention. The region, historically reliant on coal, is experiencing an out-migration of its youth and skilled workers, drawn away by the promise of better opportunities. This exodus is symptomatic of broader issues: diminishing job prospects, declining health outcomes, reduced educational attainment, and stagnant wages. Without a strategic shift towards economic diversification, including the embrace of alternative energy projects, these trends are likely to accelerate, further eroding the region's socioeconomic fabric. Between 2011 and 2022 coal mining employment declined by 57% in Appalachia compared to 43% in the rest of the United States. Moreover, as seen in figure 1. Central Appalachia in comparison to Southern and Northern Appalachia has dropped the most at 63% in terms of coal mining employment("Coal Production and Employment in Appalachia, Summer 2023," 2023) The continued decline in coal mining employment, compounded by a lack of investment in emerging industries, threatens to entrench Southwest Virginia in a cycle of poverty, limited economic mobility, and an over-reliance on a dwindling sector. The projection ahead is clear: without a pivot to sustainable development and economic diversification, Southwest Virginia faces a future marked by exacerbated social and economic challenges, making the need for intervention not just urgent but essential for the region's revival.

Figure 3. Coal Mining Employment, Appalachian Coal-Producing Subregions



[2]

This figure compares coal employment levels within three Appalachian coal producing subregions for the period 2001-2022. The y-axis represents an index with the base year 2001 which is equivalent to 100% employment.

The presence of federal grants is a pivotal factor in enabling clean energy projects within former coal communities, such as those in Southwest Virginia. Historically, the absence of such financial support rendered these initiatives unfeasible due to high upfront costs and financial risks. Federal grants bridge this gap, providing the necessary resources to undertake sustainable energy projects that were previously beyond reach. This shift towards leveraging federal assistance marks a significant change, making it possible to pursue clean energy transformations that contribute to economic revitalization and environmental sustainability in regions historically dependent on coal. Financial assistance through programs such as the U.S Economic Development Administrations Assistants to Coal Community Initiative, Appalachian Regional Commission's Partnerships for Opportunity and Workforce and Economic Revitalization Initiative, and the U.S department of the Interior's Abandoned Mined Land Economic program, alongside tax credits and support for dislocated workers, underscores a strategic commitment to sustainable development(Lawhorn et al., 2023).

[2] Figure 1. Is taken from *Coal Production and Employment in Appalachia, 2023*- ("Coal Production and Employment in Appalachia, Summer 2023," 2023)

Evidence on Potential Solutions

Utility Solar

Photovoltaic (PV), more commonly known as solar power, is the conversion of incident solar energy into electrical energy. PV has been deemed a suitable renewable energy method even for areas that have fluctuating levels of sun exposure. Solar power continues to be embraced nationally as a suitable alternative, especially in former coal-dependent communities. As the United States undergoes a transition away from coal, dedicated funds have been allocated to retrain coal miners and workers, with a focus on the Appalachia region. To facilitate this transition, an assessment is made for each type of coal position to identify the closest equivalent PV position, and the re-training time is determined (Mendelsohn et al., 2012). Utility scale solar power accounts for solar projects over 1 MW. In Kentucky, the conversion of the Starfire mine to a solar farm offers an example of the economic benefits to local and state governments. It's estimated that over the project it would offer $400 million in tax revenue over the project lifeline. Kentucky as fellow member of central Appalachia offers a similar historical dependency on coal paralleling its overwhelmingly negative effects on their community. A parallel opportunity are the abandoned mine sites in Southwest Virginia. The flat land left behind as a product of strip mining in Southwest Virginia offers viable areas for a utility scale solar farm. In Virginia, there are over 3,000 abandoned landmines, presenting a unique opportunity, particularly concentrated in Southwest Virginia. The Nature Conservancy, in partnership with Sun Tribe, has recently embarked on projects to convert six of these abandoned surface mines into utility-scale solar fields. This forward-thinking initiative is bolstered by the utilization of Delegate Kilgore's Virginia Brownfields and Coal Mines Renewable Energy Grant Fund and Program. By tapping into this grant fund and program, these expansive projects are not only overcoming the hurdles but actively capitalizing on the abundant potential offered by the region's abandoned mines (The Nature Conservancy, 2021). Furthermore, utility solar projects have the potential to attract companies searching for low-cost renewable energy power(*Starfire - Community*, n.d.). Utility solar projects have the potential to not only augment the tax base of local communities, but also offers the opportunity for economic stimulations through land lease programs, reductions of community electricity costs, and the direct and indirect creation of jobs (Pitt et al., 2018). While Southwest Virginia offers similar sites for projects like the Starefire mine it is important to recognize the sociopolitical and economic, i.e. taxes and subsidies might beget different outcomes and thus a project undertaken must take these into consideration.

Utility Solar Adoption and Implementation Considerations

The adoption and implementation of utility solar projects in Southwest Virginia present a multifaceted strategy that intertwines economic, environmental, and community considerations. The policy landscape supporting utility solar initiatives is further shaped by federal incentives such as the revamped Investment Tax Credit (ITC) and Production Tax Credit (PTC). These financial incentives significantly mitigate the initial capital costs of solar projects, making them more financially viable(US EPA, 2022). The cost of solar panel systems in Virginia, currently averaging $3.03/W including installation, is further reduced by 30% through federal tax credits, fostering economic feasibility and promoting widespread adoption(*Virginia Solar Panel Cost*, n.d.). Moreover, Southwest designation as both a low income area and energy community unlocks bonus credits for it solar projects to aid in its implementation(*Federal Solar Tax Credits for Businesses*, n.d.).

Collaboration with Dominion, the primary energy provider in Southwest Virginia, is pivotal for successful grid integration. The Solar Partnership Program, allowing the construction and operation of company-owned solar facilities, provides a structured avenue for collaboration. Additionally, selling excess energy back to the grid presents a profit opportunity, aligning with the growing demand for renewable energy in Virginia(*Dominion Energy*, n.d., 2021). State targets of achieving 5,500 MW of wind and solar energy by 2028, with 30% of the electric system powered by renewables by 2030 and 100% by 2050, further underscore the urgency and relevance of utility solar projects(*2022 Virginia_Energy_Plan.Pdf*, n.d.,2022).
Jobs transferability for coal workers in Southwest Virginia matches well with renewable energy projects like solar.

The transition from coal jobs to solar and renewable energy projects not only addresses the evolving energy landscape but also offers a pathway for the transferability of crucial job skills. While not directly aligned, the investment in renewable energy projects creates employment opportunities that significantly contribute to the health of the local economy. This shift not only attracts young professionals seeking sustainable career paths but also provides employment options for locals invested in their communities(*Southwest Virginia Community College News*, n.d.,2021). The job prospects, a mix of long-term and project-based roles, are centered around operational and maintenance responsibilities, with construction jobs playing a significant albeit secondary role. Moreover, the crossover in people skills is noteworthy, as solar technicians must effectively communicate complex topics in an accessible manner, emphasizing professionalism and punctuality. The commitment to workforce development is exemplified by initiatives such as the Virginia Coalfield Economic Development Authority's support for Southwest Virginia Community College. The funding is directed toward training and development programs in renewable and alternative energy, including the installation of a solar panel project on campus, ensuring a skilled workforce ready to contribute to the sustainable energy sector(*Southwest Virginia Community College* n.d., 2021).

In considering the transition from coal jobs to renewable energy projects in Southwest Virginia, potential community input and concerns are crucial to address.
Understanding the alignment of these projects with the community's history and values is equally important. Explaining how the initiatives respect and honor the region's coal-mining heritage while offering a sustainable and forward-looking economic path can alleviate apprehensions. Engaging with the community to highlight the benefits, such as job diversification and enhanced environmental stewardship, ensures that the projects resonate with the values and aspirations of the residents.

Community involvement through town hall meetings, workshops, and open forums allows for transparent discussions, ensuring that local voices are heard and incorporated into the decision-making process. By addressing concerns, showcasing successful precedents, and emphasizing alignment with community values, stakeholders can work collaboratively to ensure the success and acceptance of renewable energy projects in Southwest Virginia.

Utility Wind Power

Wind power holds significant promise for Virginia, offering both economic and energy benefits. Wind turbines harness the kinetic energy of the wind, using blades to convert it into electricity through a generator. The vast rural landscapes of central Appalachia present ideal opportunities for wind power facilities.

Wind power provides direct financial benefits to local communities through tax revenues and land lease payments(*Potential Impact of the Development of The Wind Energy Industry*, n.d.). Wind power can be an essential long-term solution, with net benefits in health and the local economy that can surpass those of coal, particularly concerning state taxes(Brown et al., 2012). For instance, while mountain-top coal production generated an additional $36,000 in additional taxes, wind energy development has the potential to generate an average of about $1.74 million in local property taxes annually(*Land-Based Wind Research*, n.d.).

However, wind power may have its limitations, especially in onshore localities like Southwest Virginia. While it holds long-term potential, it may not fully replace the economic contributions of coal mining in the short term. The transition to wind power energy should be seen as a long-term strategy, with its impact growing over time and balancing both economic and energy transitions as Southwest Virginia moves away from coal(*Land-Based Wind Research*, n.d.)

Utility Wind Implementations and Adoption Considerations

The successful adoption and implementation of wind energy projects in Southwest Virginia require a nuanced approach that addresses both the economic potential and the unique challenges associated with onshore wind power in the region.

One pivotal aspect is the favorable policy environment supported by federal tax credits and subsidies outlined in the Inflation Reduction Act. These incentives, extending the Investment Tax Credit (ITC) and Production Tax Credit (PTC) through 2025, offer financial support for wind projects. Leveraging additional credits, similar to those for solar, for siting in energy communities or low-income areas enhances the economic viability, promoting a symbiotic relationship between wind energy initiatives and historically exploited communities(US EPA, 2022).

In Southwest Virginia, the potential for job transferability and economic growth through wind utility jobs is becoming increasingly evident. Drawing parallels with solar energy, job retraining programs specifically designed for former coal workers offer a vital bridge to engage with renewable energy projects. Notably, Invest SWVA has established a robust job retraining partnership for offshore wind projects in collaboration with Mountain Empire, Southwest Virginia, Virginia Highlands, and Wytheville community colleges(Payne, 2022). This strategic investment in job retraining acknowledges the high transferability of skills from fossil fuel industries to renewable energy, presenting a valuable opportunity for Southwest Virginia to harness these existing skills. By capitalizing on these initiatives, the region can not only adapt to the evolving energy landscape but also foster economic growth and diversification, utilizing the well-established expertise of its workforce in the pursuit of a more sustainable future.

However, the history of wind projects facing community and local government pushback in counties like Pulaski, Wise, Tazewell, Carroll, Floyd, and Rockingham necessitate proactive measures(Mamon, 2021). Launching awareness and community buy-in campaigns is crucial, addressing concerns related to the visual impact of tall wind turbines in the mountainous terrain of Southwest Virginia. Such campaigns must emphasize the direct financial benefits to local communities, including coal tax revenues, land lease payments, and potential increases in individual income(*U.S. Department of Energy Technology Campaigns*, n.d. 2022).
As Southwest Virginia navigates the transition from coal to wind power, comprehensive assessments and community-driven initiatives will play a pivotal role in ensuring a sustainable and economically beneficial energy future for the region.

Soybean Biofuel

Biodiesel fuel is a renewable alternative to petroleum diesel that can be sourced from vegetable oils, biodegradable waste products such as wood chips, animal fats, and restaurant grease(US EPA, 2014) . Biodiesel is a positive alternative to traditional petroleum diesel because of its carbon neutrality(Ogejo & Grisso, 2021). As Virginia continues to embrace clean and renewable energy opportunities soybean biodiesel offers a positive alternative especially for the growing energy demand in Virginia(Gabel, 2023). While burning any type of diesel emits carbon biodiesel offsets its CO2 emissions by the crop absorption of CO2 upon growth. In terms of biodiesel combustion, biodiesel has a 3:1 energy balance providing over three times the amount of energy it takes to produce it. Additionally, in comparison to fossil diesel, it releases significantly fewer pollutants across the board(Chintala, 2019). Biodiesel production fits seamlessly with the Virginia clean energy goals.

Soybean oil, as the most utilized vegetable oil used for biodiesel and Southwest Virginia, is uniquely situated to capitalize on both the refinement of soybean oil into biodiesel and the farming of soybeans(*Soybean Oil Comprises a Larger Share of Domestic Biodiesel Production - U.S. Energy Information Administration (EIA)*, 2020.). Southwest Virginia's primary agricultural focus has been cattle, but farming soybeans offers great economic benefits for the region. Soybeans are the number one export for Virginia's agricultural and forestry exports and in 2022 at 2.3 billion dollars, giving much-needed boost and diversity to Southwest Virginia's economy(Virginia Department of Agriculture, 2021).

Soybean refinement and biodiesel offer economic benefits. in rural Montana's Polk County, a study indicates that the construction of a soybean crush and biodiesel plant had a significant economic impact, contributing $134.0 million to economic activity. This, in turn, led to the creation of 820 jobs and generated $43.1 million in labor income. The ongoing operation of the soybean crush and biodiesel plant has further boosted economic activity, resulting in $322.8 million in new economic output, including $17.2 million in labor income. The plant is anticipated to create 330 additional jobs(Tuck et al., 2019).

Moreover, the impact extends to soybean purchases, supporting 180 farm-related jobs and contributing $58.9 million to farm-related output. This includes $12.2 million in labor income. Looking at the broader regional perspective, the plant's presence has resulted in $323.9 million of new economic activity across an 11-county region. This includes $18.1 million in labor income, with an additional 330 jobs being created. Soybean purchases are projected to support 980 farm-related jobs and contribute $257.8 million to farm-related output, including $67.3 million in labor(Tuck et al., 2019). This offers a positive estimate for Southwest Virginia, a smaller region for the potential economic impact of Soybean crushing and biodiesel refinement.

Soybean Biofuel Implementation and Adoption Considerations

Soybean biodiesel in Southwest Virginia faces two primary implementation challenges: Refinery financing and long-term partner commitment. Although soybean biodiesel refinement offers positive economic benefits its initial investment offers significant risk to its investors due to its dependence on the petroleum diesel market. The average national price for biodiesel (B-20)is 4.42/gallon compared to regular diesel at 4.52/ gallon(*Alternative Fuels Data Center*, n.d.). Although the price currently for biodiesel is less right now than petrol diesel this is only sometimes the case. Within the market, petrol-diesel prices are likely to fluctuate similarly to gas prices. This poses a greater risk to soybean biodiesel refineries and often scares investors due to the stagnant price of biodiesel in comparison to when petrol-diesel prices dip well below and when the price of feedstock goes up as well.

Long-term partner commitment is a key aspect of implementation for both the survival of the refinery itself as well as. Finding biodiesel buyers is crucial in sustaining the industry. Without a commitment to buy biodiesel refineries, you have insatiable markets for both the refinery and the suppliers. Having a strong relationship with buyers and leveraging agreements with large partners in Virginia will be an important aspect of success(Tuck et al., 2019). Potential partners particularly in Virginia that Southwest Virginia can capitalize on are data centers. Virginia has been deemed the data center capital of the world with nearly 300 data centers just in Northern Virginia(Zorn et al., 2020). Data centers continue to grow throughout Virginia requiring more and more energy to sustain themselves as of 2022 data centers accounted for 21% of the Dominion Energy sales(Dominion Energy, 2023). The growing energy demand from data centers is making Virginia's renewable energy goals unrealistic. Thus, Data centers offer excellent potential partners for refineries in Southwest Virginia. Furthermore, the Department of Defense offers other valuable partners because of the DODs goal to obtain 25% of its energy from alternative sources by 2025(Richards, n.d.).

Evaluative Criteria

Cost/Economic Impact

In evaluating the cost and economic impact of a project, my analysis encompasses both initial and long-term expenses, alongside the economic benefits. Initially, we consider installation costs, which include materials, labor, and permits. For long-term costs, we factor in annual operating and maintenance expenses, again covering labor, materials, and equipment. These costs are discounted over the project's lifespan to calculate its net cost. On the economic impact side, we account for local wages, gross revenue during the installation and construction period, and ongoing annual revenue and wages discounted over the life span of the project. This overall impact is also discounted over 20 years and summarized to assess the project's profitability by comparing the gross costs against economic benefits, with all values adjusted to 2024 dollars for consistency. For a project to have a positive impact on the regions we look at projects that generate a positive net profit over the life span of the project and generate long terms jobs in the local community. In measuring cost of these projects state and federal grants, tax credits, and subsidies are not taken into consideration. In calculating the costs of these projects, state and federal grants, tax credits, and subsidies are excluded from consideration. This approach enables individuals considering alternatives to determine the gross cost more accurately. Additionally, profit from electricity generation is not included for two primary reasons. The first is that accurately assessing the revenue generated would require knowledge of how electricity prices will change over the course of the project, as well as how demand will influence these prices. Additionally, this assessment would depend on variable factors, such as the integration of solar-generated electricity with other power sources, making accurate predictions infeasible. Secondly, including profit from electricity generation is beyond the scope of this report. The main objective of this report is to overview the economic impact versus the cost of renewable energy projects, thereby assessing which alternative would generate the most positive long-term effects for the region.

Equity

I examine equity within Southwest Virginia through the lens of economic revitalization and community wellbeing. Equity is pursued by:

1. **Local Job Generation:** Creating employment opportunities in sectors with potential for growth, specifically focusing on positions that are sustainable and resilient against economic downturns. Prioritizing industries that can provide job security and career growth for residents is key.
2. **Wage Standards:** Ensuring that the jobs created offer wages above the regional average. This is not merely to increase income levels but to raise the standard of living and contribute to the economic upliftment of the community.
3. **Local Spending:** In assessing equity for Southwest Virginia, the report highlights the promotion of local spending, which aims to circulate the economic benefits within the community.

A viable equitable alternative actively strives for local job creation at wage rates surpassing the regional average, ensuring that the financial benefits are distributed throughout the population. To evaluate the effectiveness of such initiatives, metrics such as job creation figures[3], wage growth, and local economic spending data are crucial. Furthermore, deploying surveys, impact assessments, and economic reports will provide a mix of quantitative and qualitative evidence necessary for evaluating the performance in relation to the equity criterion.

Political Feasibility

To assess political feasibility, my approach involves a qualitative analysis of the attitudes held by local political figures, including town officials, zoning board members, and district legislators. I specifically look at communities with abandoned mine lands and gauge the perspectives of state delegates and local governments towards these projects. This review helps to understand the political landscape and determine the viability of each project based on the support it may receive from local and state stakeholders.

[3] Job creation and wage expansion are measured qualitatively in terms of local job generation when measuring equity. This is to avoid any type of double counting.

Analysis of Alternatives

Analysis of Alternative 1: Utility Solar Farm

Cost

The JEDI Solar PV Model has estimated the installation cost for a 300MW solar project in Wise County, VA at **$348** million, with the model utilizing local data for accuracy. Installation costs include materials & equipment, labor costs, and other costs such as permitting. This excluded variable costs such as the added costs of developing Utility solar fields on formerly mined lands. Ongoing annual direct operation and maintenance costs are projected to be **$6.0** million (*JEDI Photovoltaics Model*, n.d.). The net cost, including the initial installation and building costs as well as the annual operation and maintenance costs, discounted each year of operation amounts to **$440** million dollars over the life span of the solar. The model incorporates local data such as tax rates, land lease agreements, and Bureau of Labor Statistics data. For a comprehensive breakdown of the cost components and economic inputs and outputs of the project, see Appendix A.

Economic Impact

The economic impact is divided into two periods initial construction and installation period ranging from 8-14 months[4] and an annual impact totaling at 25 years[5] which is the typical life of a solar panel ("Midway Solar Center - Sun Tribe Development," n.d.), then further categorized into jobs and earnings, gross output, and community value added. While jobs are not traditionally included in benefits section as it here, they are because of the overarching goal of the project which is to bring full time jobs and economic stability into the locality.

- **Jobs Created**: 1,591 initial construction and installation jobs with gross earnings of **$112 million**. This comes out to be an annual salary of **$70,000.**
  Annual Jobs created are far less at approximately 72 full time jobs, but still with substantial pay at **$67,000.**
- **Output**: The total economic activity generated in the county is estimated at **$218 million** during the initial construction and installation period
  - Annual output **$8.4 million**
- **Value Added**: The community benefits from a value-added of **$156 million.**
  - Annual value added is **$6.3 million.** (*JEDI Photovoltaics Model*, n.d.).

By incorporating the initial output and net earnings from full time jobs created during the installation period and combining it with the annual earnings from full time jobs created and annual output from the solar project, discounted each year over the life span of project the calculated gross net benefit is **$534** million. The overall net profit, accounting for intermediate costs, is **$94** million for a 300 MW utility solar project.

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[4] To streamline the calculation and comparison of alternatives the construction period of a Utility solar farm was averaged at one year.
[5] To streamline comparison amongst alternatives project lifetimes were averaged at 20 years to calculate benefits and costs.

Equity

Equity is measured by local job creation and the extent of local production and spending. Equity considers the extent to which local jobs are created and the number of locally sourced workers. Secondly, it assesses the extent to which project spending circulates within local economies, supporting local businesses and services, and contributing to community development and revitalization.

- **Local Jobs**: 1,591 full-time jobs during construction with long-term employment estimated at 72 jobs, with gross annual earnings of $**70,000 thousand** and **$67,000 thousand** respectively.
- **Local Spending**: Yearly local spending is estimated to be **$5.5 million**(*JEDI Photovoltaics Model*, n.d.)

Political Feasibility

The primary actors needed on board for project are the local permitting agencies which are the board of supervisors and the zoning board (*Solar Energy Resources | Wise County, VA*, n.d.). Furthermore, engagement from congressional leaders helps facilitate broader community involvement, thus the support from multiple state delegates of the district such as Terry Kilgore increases the likelihood of robust community and political support (*Terry Kilgore*, n.d.). Moreover, statements from local leaders, such as Cliff Carson, Chairman of the Wise County economic and industrial development office a major collaborator with the zoning board and board of supervisors, underscore the high political feasibility of such a project(Washington, 2021). Such endorsements from influential figures are often pivotal in swaying public opinion and ensuring sustained community backing. Furthermore, the Wise County homepage articulates a clear intent to foster solar initiatives across various scales, from residential to commercial and utility-level projects. A critical indicator of political feasibility is local support, which appears robust in this case, Virginia's regulatory environment, which includes a 'permit by rule' framework for solar projects and the sanctioning of utility solar projects, reduces bureaucratic hurdles and demonstrates state-level encouragement (9VAC15-60-30, (2012)) (Washington, 2021.).

Wise County's proactive steps, such as the implementation of an ordinance to share revenues from solar energy projects, signify local governmental endorsement. The county's recent approval of site remediation for a solar project on abandoned mine land further highlights this support (§58.1-2636, 2020).

Another significant site, Dickenson County, also exhibits positive local sentiment toward solar energy developments. The willingness to repurpose approximately 1,200 acres of the former Red Onion surface mine for such purposes is a testament to this (*Solar Partnerships | Virginia | Dominion Energy*, n.d.).

In conclusion, the alignment of local and state-level support, coupled with the facilitative regulatory landscape, suggests a high level of political feasibility for utility-scale solar projects for these localities.

Analysis of Alternative 2: 225 MW Utility Wind Farm

Cost

The JEDI Utility wind model for a 225 MW wind farm encompasses initial construction and developmental expenses is **$289 million**. The annual operation and maintenance costs amount to approximately **$9.9 million** covering direct operations and maintenance of the wind farm. The gross cost of the wind farm, including the installation and construction cost and annual direct operational expenses, discounted over the life span of the project, not taking into consideration tax incentives and subsidies provided the Virginia Clean Economy Act, Inflation Reduction Act, nor the Build Back Better Act, is **$441 million** (*JEDI Wind Models*, n.d.) For a comprehensive breakdown of the cost components and economic inputs and outputs of the project, see Appendix B**.**

Economic Impact

The economic impact is divided into two periods initial construction and installation period ranging from 6-12 months[6] and an annual impact totaling at 30 years[7] which is the typical life of wind turbines(Hoen et al., 2018). Then further categorized into jobs and earnings, gross output, and community value added.

- **Jobs Created**: 250 initial construction and installation jobs with gross earnings of **$20 million**. This comes out to be an annual salary of **$82,000.**
  Annual Jobs created are far less at approximately 39 full time jobs, but still with substantial pay at **$66,000.**
- **Output**: The total economic activity generated in the county is estimated at **$48 million** during the initial construction and installation period
    - Annual output **$8.6 million**
- **Value Added**: The community benefits from a value-added of **$29 million.**
    - Annual value added is **$6.2 million.** (*JEDI Wind Models*, n.d.).

The gross net economic impact of the wind farm discounted over the life span the project, including the revenue generated from installation and construction to the annual output, is **$301** million, Considering the discounted cost and economic impact of the wind farm the project would cost the locality **$-140** million.

Equity

- **Local Jobs**: The project is expected to create **247** full-time jobs with gross earnings of **$82,000** during the initial construction. Long-term operational employment stabilizes at **39** jobs with an estimated annual income of **$66,000.**
- **Local Spending**: Yearly local spending is estimated to be **$1.2 million**(*JEDI Wind Models*, n.d.)

[6] To streamline the calculation and comparison of alternatives the construction period of a Utility wind farm was averaged at one year.
[7] To streamline comparison amongst alternatives project lifetimes were averaged at 20 years to calculate benefits and cots.

Political Feasibility

Governor Glenn Youngkin has forged a significant land development agreement with officials from Wise and Dickenson Counties, aimed at revitalizing Southwest Virginia through sustainable energy solutions. This agreement facilitates Energy Transfer and Energy DELTA Lab to spearhead the commercialization and deployment of both conventional and innovative energy technologies over an extensive tract of 65,000 acres of land that has been previously subjected to coal mining (*Governor Glenn Youngkin | Governor.Virginia.Gov*, n.d.). This substantial repurposing effort is indicative of a strong political commitment to shifting towards renewable energy sources, which inherently boosts the political feasibility for projects like utility-scale wind energy. Given the proactive role of state officials in endorsing this transition, coupled with the legislative support from the Virginia Clean Economy Act, there is a clear indication of robust political support. Considering these developments, one can conclude that there exists a high level of political feasibility for launching a utility wind project in Southwest Virginia on the gubernatorial level and state delegate level. However, at the local level there has been push back in terms of permitting for Utility Wind project due to what some describe as NIMBYSM that is "Not in my backyard". Residents in the area are adverse to wind projects because of the supposed garish nature of large wind turbines in their vicinity (Mamon, 2021). Garnering support to overcome this is feasible but would require changing negative local attitudes towards utility wind. The political feasibility level would be marked at mid-high requiring the executing agent to garner local support for successful implementation.

Analysis of Alternative 3: Soybean Biofuel Plant

Cost

The Jobs and Economic Development Impact (JEDI) model has been utilized to simulate a soybean biofuel plant capable of producing 3.25 million gallons per year in Wise, Virginia. The construction of this facility is expected to cost **$31million**, with annual maintenance costs of approximately **$4.7 million**. The gross cost is **$102 million** discounted over a 20-year period(*JEDI Biofuels Models*, n.d.). For a comprehensive breakdown of the cost components and economic inputs and outputs of the project, see Appendix C**.**

Economic Impact

- Output: **$61 million** generated from the plant's activities.
- Value Added: **$35 million** representing the net economic benefit.
- Employment: Creation of 242 jobs with gross earnings of **$96,000** during the construction period, and 7 ongoing operational jobs averaging a gross income of **$75,000** annually.

Over the 20-year period the discounted net economic impact is **$182** million, This accounts for the economic output during the initial construction and installation period as well as the annual output. The net profit from this project is **$81** million(*JEDI Biofuels Models*, n.d.).

Equity

- **Local Jobs:** During the initial construction period is 242 full times are generated with an average salary of **$96,000.** Long-term full-time jobs after the initial construction is 7 with an average salary of **$76,000.**
- **Local Spending**: Annual community spending is estimated at **$3.4 million.**

Political Feasibility

Biofuels offer an innovative approach to energy production and align with Governor Youngkin's collaborative efforts with Wise County and the Energy DELTA Lab. However, they do not currently benefit from tax incentives under the Inflation Reduction Act (IRA) or the Virginia Clean Economy Act (Martinez, 2023). This lack of fiscal incentives may discourage local officials from supporting biofuel projects due to the significant financial implications of proceeding without government subsidies. Additionally, there has been limited local discourse on developing a biofuel production facility, indicating low support from key local actors and permit authorities, which presents a challenge. Despite this, recent biofuel projects in Southwest Virginia have been praised by Governor Youngkin for creating jobs and providing clean energy solutions (Martinez, 2022), demonstrating that, although not a primary topic of political discussion, biofuel projects can gain traction if effectively lobbied. Thus, in assessing the political feasibility of biofuel projects, it is wise to consider their potential as medium to low.

Outcome Matrix

Criteria/Project	**Net Benefit**	**Equity -Job Generation and Local Spending**	**Political Feasibility**
Utility Solar on Abandoned Mined Lands	High: $94million.	**Local Full time Jobs**: **72** jobs, with gross annual earnings at **$67,000**	**High**
Utility Wind	Low: -$140 million	**Local Full Time Jobs: 39** jobs with gross annual earnings at **$66,000**	**Med-High**
Soybean Biodiesel	Medium: $80million	**Local Full-Time jobs**[8]: **7** jobs with gross annual earnings **$76,000**	**Med-Low**

Recommendation

InvestSWVA should prioritize the initiation of a Utility Solar project on abandoned mined lands, considering the analysis conducted on equity, cost, and political feasibility criteria. Utility Solar projects not only offer the strongest long-term investment returns despite the initial developmental costs but also face the least political resistance, particularly with the robust local support from state legislators and county supervisors in Dickenson and Wise County. Furthermore, the implementation of a Utility Solar project is expected to create a substantial number of full-time jobs post-construction, significantly contributing to local employment rates. Although these roles may offer a lower average salary, the quantity and stability of these jobs compensate for this tradeoff, underpinning the project's overall benefit to the community.

There are two primary reasons that Utility Solar hasn't been adopted which are: Political will and funding. Utility solar projects, despite being good investments, the upfront capital needed to initiate the project is immense and because Southwest Virginia is already an economically distressed region it has not been able to capitalize on these opportunities. Utilization of the available federal grants provided by programs such as the Build Back Better

[8] This calculation does not include farmers, transporters, storage staff, nor farmer but only staff directly related to the operation and maintenance of the soybean biofuel facility.

Act and the Inflation Reduction Act will be paramount in overcoming the upfront capital costs(U.S Department of the Treasury, 2023) Secondly, there has been local resistance to clean energy as it was seen as a direct threat to the coal industry i.e. their livelihoods. This fear of change and contributed greatly to the slow uptake of solar projects in the region (Kideckel, 2019).

Implementation

Overview

The implementation of a 300MW utility solar farm on abandoned mined land is a multi-faceted operation requiring the collaboration of various stakeholders and a phased approach to maximize tax incentives and spread out the benefits over time. InvestSWVA must liaise with the county boards, ensuring all zoning and permits are current and facilitate the acquisition of the land. Securing funding through grant proposals and designing projects to meet federal tax credit incentives are critical. The success hinges on balancing the technical components—planning, permits, funding—with equity considerations such as job sourcing and revenue sharing.

Stakeholders

InvestSWVA and Delta Lab – Implementer and Manager

InvestSWVA, alongside Delta Lab, acts as the driving force behind the Utility Solar project. As implementers and managers, they are responsible for coordinating the application process for funding, tax incentives, and subsidies. Their role encompasses the management of multi-tiered project facets, ensuring adherence to federal and state regulations. They must also handle the intricate task of securing permits and fostering relationships with local governments and community stakeholders. As implementers, InvestSWVA and Delta Lab, has completed multiple regional projects working with local actors such as: Lee County Office of Virginia Cooperative Extension, Lonesome Pine Regional Industrial Facilities Authority, Virginia Department of Mines, Minerals, and Energy plus Mountain Empire Community College’s Smart Farming program. Furthermore, InvestSWVA has effectively secured federal and state funding to complete the project s(Payne, 2021.). One area to focus on is creating a clear project plan and timeline with the local community colleges to make sure that work force development initiative for the project is properly suited to the project installation period and years of operations. InvestSWVA should take cues from their previous work for development partnerships with Mountain Empire community college to ensure seamless timeline integration(Payne, 2022).

Board of Supervisors and Zoning Board of the County of Wise Virginia – Regulatory and Compliance Overseers

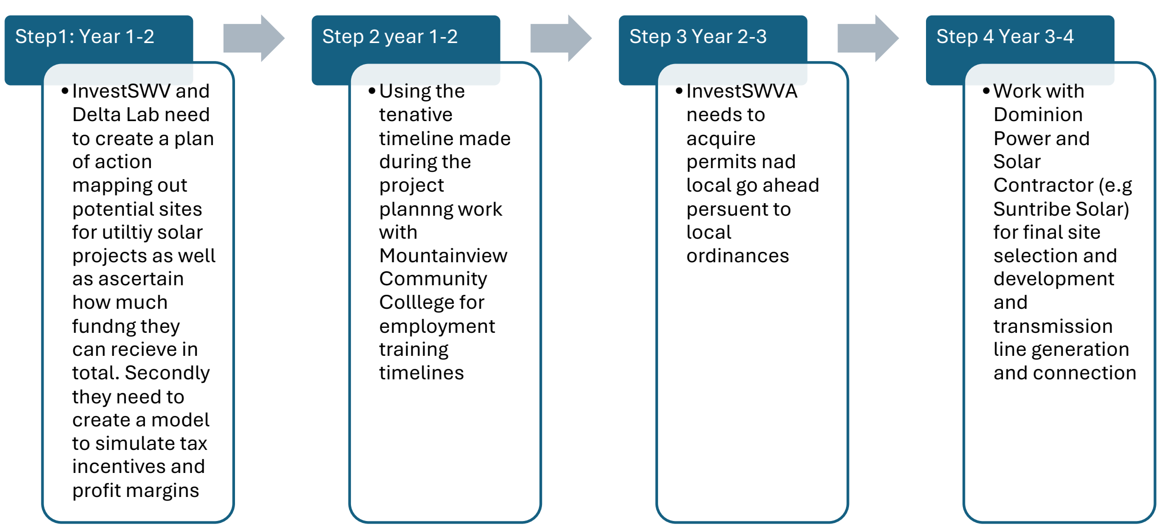
The Board of Supervisors and Zoning Board are crucial for the Utility Solar project's regulatory compliance and local governmental approval. They are tasked with granting permission to build large-scale solar installations and ensuring these projects align with local ordinances, such as the “Revenue Sharing Ordinance for Solar Energy Projects.” Their involvement is vital for maintaining the project within legal parameters and for the community's economic benefit. Wise County has an entire page dedicated to solar resources outlining things such as financing incentives, and tax exemptions as well as a statement professing their commitment to the solar and promote its adoption throughout the community. Overall, the board of supervisors and zoning regard solar projects quite favorably and there is likely to by few if any objections to large scale solar projects if the revenue sharing agreement is honored.

Dominion Power – Grid Integration and Infrastructure Partner
Dominion Power, as the primary energy supplier, is the linchpin for integrating the Utility Solar project into the larger energy grid. They will collaborate closely with Sun Tribe Solar to establish the necessary infrastructure, which includes constructing transmission lines. Their technical expertise and existing grid framework are indispensable for the project's success. Dominion has participated and is actively looking for more solar projects with the growing energy demand. Dominion Power has outwardly spoken about the promising aspects of projects like utility solar in Southwest Virginia especially on former mined lands (*The Nature Conservancy, Dominion Energy Announce Innovative Collaboration for Solar Development on Former Coal Mine in Southwest Virginia*, 2021).

Sun Tribe Solar – Construction and Feasibility Expert
Sun Tribe Solar is likely to be at the forefront of constructing the solar fields and overseeing the commissioning of the projects. Their responsibilities extend to conducting site evaluations and feasibility studies, which are foundational for determining the project's practicality. Their role as implementation doers is critical in translating the project plans into tangible, operational solar fields.

Mountain Empire Community College – Workforce Development and Training Facilitator
Mountain Empire Community College will partner with InvestSWVA to ensure that the project timeline aligns with workforce development initiatives. They will play a dual role as both implementers and managers by coordinating training programs for local individuals. Their involvement is key to ensuring that the solar fields have a skilled and prepared workforce, thereby bolstering job creation and contributing to the project's long-term sustainability.

Next Steps



Potential Challenges and Hurdles

In the realm of implementing a 300MW utility solar farm on abandoned mined lands, several potential challenges could impede progress. Timing challenges represent a pivotal hurdle. To overcome this, a rigorous project management plan must be established, delineating clear milestones and deadlines while allowing flexibility for unexpected delays. This could involve a phased implementation strategy to mitigate risks associated with delays and ensure critical stages of the project are completed on schedule.

Incomplete funding is another significant barrier that could derail the project. This can be preempted by securing multiple funding sources and maintaining a reserve fund to cushion the financial impact of any shortfalls. Engaging in continuous grant writing and fostering relationships with potential investors early in the project can also help alleviate funding issues.

Lastly, unusable areas for solar placement due to land constraints or environmental protection regulations present a logistical challenge. To address this, thorough site surveys and environmental impact assessments must be conducted prior to finalizing project locations. Leveraging GIS mapping technology to identify viable areas and consulting with environmental experts can ensure that the selected sites are both suitable for solar energy production and compliant with environmental regulations.

By anticipating these challenges and proactively devising strategies to counteract them, the project can maintain momentum and adapt to obstacles as they arise.

Conclusion

In summary, the initiative to establish a Utility Solar project on abandoned mined lands in Southwest Virginia offers a transformative opportunity for a region in need of revitalization. This project is not simply an investment in sustainable energy—it is an investment in the community itself. By harnessing the untapped potential of these lands, the project will help diversify the local economy, which has been distressed by the decline of traditional mining industries. It will bring much-needed jobs to the area, stimulate economic growth, and foster a sense of innovation and progress. Furthermore, this shift towards renewable energy sources will help mitigate environmental concerns associated with the region's historical mining activities, contributing to a healthier ecosystem.

The vision for Utility Solar goes beyond the immediate economic benefits. It represents a beacon of sustainable development that could set a precedent for similar communities nationwide. The commitment to this project is a commitment to the people of Southwest Virginia, providing them with the tools for a brighter, more prosperous future. The successful implementation of Utility Solar on abandoned mined lands is poised to uplift and empower the community, propelling Southwest Virginia into a new era of economic and environmental well-being.

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General Assumptions

Project Operating Lifespan: All projects are assumed to have an operating lifespan of 20 years.
Discount Rate: A discount rate of 3% is applied to account for the time value of money, with all values expressed in 2024 dollars.
Federal Tax Incentives: Costs do not account for any federal tax incentives for clean energy projects, providing a conservative cost estimate.
Project Location: All projects are in Virginia, which may influence specific regulatory and environmental considerations.
Year of Construction: Construction for all projects is slated for 2028.
Construction Period Jobs: Jobs related to the construction period are considered full-time, based on 2080 hours annually.
Spending of Profits and Tax Abatement: The analysis excludes the impacts associated with the spending of profits and assumes no tax abatement unless otherwise noted.
Wage Averages: Wage averages are aligned with the national average for positions associated with each project, reflecting labor costs realistically.

Capital Expenditures (CAPEX)

Modeling Approach: The CAPEX estimates in the BCA are derived from a detailed analysis of each project component. This includes construction costs, machinery and equipment expenses, land acquisition, and any necessary infrastructure upgrades, ensuring comprehensive coverage of all necessary expenditures.

Benchmarking: These modeled estimates have been rigorously benchmarked against industry standards for similar projects. This involved reviewing data from recently completed projects, industry reports, and supplier quotes, ensuring that the estimates are competitive and realistic.

Historical Data Comparison: Where possible, the BCA compares its estimates with historical data from similar projects, adjusting for inflation, location-specific factors, and technological advancements to maintain accuracy.

Operation and Maintenance (O&M) Costs

Modeling Approach: O&M costs in the BCA are projected based on detailed operational models, including routine maintenance, labor, material costs, and any periodic major maintenance or overhaul requirements. This comprehensive approach facilitates accurate forecasting of ongoing operational expenses.

Industry Benchmarking: The projections for O&M costs have been benchmarked against industry averages for similar projects, considering the specific operational characteristics and expected efficiencies. This helps ensure that the O&M cost projections are realistic and aligned with industry standards.

Historical Data Utilization: The BCA analyzes historical operation data from projects of similar scale and technology to validate the O&M cost estimates. This comparison is crucial for accounting for potential variances in operational practices and efficiencies, allowing for refined estimates based on real-world data.

Specific Assumptions by Project

Utility Solar Project (300MW)

Size: The project is sized at 300MW, indicating its capacity to generate electricity.

Location-Specific Environmental and Regulatory Considerations: Given the project's location in Virginia, local climate conditions favorable to solar energy are assumed, as well as compliance with state regulatory requirements.

Wind Farm (225MW)

Size: The wind farm's capacity is 225MW, reflecting its potential for electricity generation.1cdattc2s

Location-Specific Considerations: The project's location is assumed to be in an area of Virginia with adequate wind resources. Local wildlife and environmental impact assessments are considered, aligning with state regulations.

Soybean Biofuel Project (3 million Gallons/Year)

Production Capacity: The project aims to produce 3 million gallons of soybean biofuel annually, using herbaceous feedstock.

Cost of Feedstock: The cost of feedstock for soybean biofuel is assumed to be $66.68, critical for calculating the production costs.

Feedstock Source: Assumptions regarding the availability and sustainability of herbaceous feedstock in Virginia are made, considering local agricultural dynamics.

Appendices

Appendix A: A comprehensive Overview of Inputs for Cost-Benefit Analysis of Utility-Scale Solar Power Projects

Appendix A provides a comprehensive financial analysis of utility-scale solar projects, detailing both the initial installation and construction costs, as well as long-term operating and maintenance expenses. The analysis leverages the JEDI Photovoltaic Model, integrating local and industry-specific data to project the economic impact of solar energy development in Southwest Virginia. It meticulously itemizes the cost components, including labor, materials, and land use, and evaluates the economic benefits such as job creation, community value added, and salary scales during the construction phase and throughout the operational lifespan. The economic impacts and costs are then discounted at a rate of 3% over the project's life, offering insights into the total cost and net profit. This detailed breakdown not only underscores the potential for significant economic return on investment but also illuminates the broader community benefits of transitioning to solar power.

Local Economic Impacts - Summary Results				
	Jobs	**Earnings**	**Output**	**Value Added**
During construction and installation period		**$000 (2024)**	**$000 (2024)**	**$000 (2024)**
Project Development and Onsite Labor Impacts				
Construction and Installation Labor	671.9	$48,562.0		
Construction and Installation Related Services	157.5	$15,095.9		
Subtotal	829.4	$63,657.9	$81,514.8	$72,170.2
Module and Supply Chain Impacts				
Manufacturing	0.0	$0.0	$0.0	$0.0
Trade (Wholesale and Retail)	34.9	$2,221.5	$7,220.7	$4,374.5
Finance, Insurance and Real Estate	0.0	$0.0	$0.0	$0.0
Professional Services	46.0	$3,087.1	$9,039.2	$5,384.3
Other Services	65.4	$7,618.5	$19,858.5	$11,856.7
Other Sectors	323.3	$20,024.4	$44,494.8	$29,729.8
Subtotal	469.6	$32,951.4	$80,613.2	$51,345.4
Induced Impacts	291.8	$15,803.0	$55,494.9	$32,060.0
Total Impacts	**1,590.9**	**$112,412.3**	**$217,622.8**	**$155,575.6**
		$112,412,293.21	**$217,622,837.00**	**$155,575,557.34**
		Annual	**Annual**	**Annual**
	Annual	**Earnings**	**Output**	**Output**
During operating years	**Jobs**	**$000 (2024)**	**$000 (2024)**	**$000 (2024)**
Onsite Labor Impacts				
PV Project Labor Only	49.6	$3,332.0	$3,332.0	$3,332.0
Local Revenue and Supply Chain Impacts	13.3	$999.1	$3,471.1	$2,062.1
Induced Impacts	8.6	$466.6	$1,638.9	$946.8
Total Impacts	**71.6**	**$4,797.7**	**$8,441.9**	**$6,340.8**
Notes: Earnings and Output values are thousands of dollars in year 2024 dollars. Construction and		**$4,797,712.68**	**$8,441,947.03**	$ 6,340,836.28
operating period jobs are full-time equivalent for one year (1 FTE = 2,080 hours). Economic impacts "D		**$67,034.17**		
operating years" represent impacts that occur from system/plant operations/expenditures. Totals may not				
add up due to independent rounding.				

The "Local Economic Impacts Summary Results" table for the utility solar project utilizes the JEDI model to meticulously quantify the jobs created, along with their associated earnings, both annually and during the construction period, adjusted to 2024 dollars. This evaluation provides a detailed breakdown of the gross output and the value added by a 300 MW photovoltaic (PV) solar facility to the local community. The inputs are systematically organized to capture the total impacts of the project, highlighting the significant positive economic influence such a facility could have on the community. The primary goal of this table is to articulate the extensive economic benefits derived from the utility solar project, emphasizing job creation, wage distribution, and overall economic growth spurred by the facility's operation.

Detailed PV Project Data Costs		
		Purchased
Installation Costs	**Cost**	**Locally (%)**
Materials & Equipment		
Mounting (rails, clamps, fittings, etc.)	$52,031,250	100%
Modules	$121,406,250	100%
Electrical (wire, connectors, breakers, etc.)	$34,687,500	100%
Inverter	$20,812,500	100%
Subtotal	$228,937,500	
Labor		
Installation	$48,562,500	100%
Subtotal	$48,562,500	
Subtotal	$277,500,000	
Other Costs		
Permitting	$17,343,750	100%
Other Costs	$10,406,250	100%
Business Overhead	$27,750,000	100%
Subtotal	$55,500,000	
Subtotal	$333,000,000	
Sales Tax (Materials & Equipment Purchases)	$14,880,938	100%
Total	$347,880,938	

The "PV Project Data Costs" table focuses on the installation costs, including materials and equipment, meticulously cataloged in 2024 dollars. This section provides a granular view of the initial capital investment required for the utility solar project, which is pivotal for understanding the financial outlay necessary to initiate the project. It underscores the importance of acquiring adequate federal funding or grants by InvestSWVA to kickstart the project, making it clear how crucial external financial support is in covering the upfront costs associated with establishing a 300 MW PV solar facility.

Discounted Cost and Benefit along with Project Profit

Year	Benefit	Cost	
0	$ 330,035,130.21	$347,880,938	
1	$12,854,039	$5,804,854.37	
2	$12,479,649	$5,635,780.94	
3	$12,116,164	$5,471,631.98	
4	$11,763,266	$5,312,264.06	
5	$11,420,647	$5,157,537.92	
6	$11,088,007	$5,007,318.37	
7	$10,765,055	$4,861,474.15	
8	$10,451,510	$4,719,877.81	
9	$10,147,097	$4,582,405.64	
10	$9,851,550	$4,448,937.52	
11	$9,564,612	$4,319,356.81	
12	$9,286,031	$4,193,550.30	
13	$9,015,564	$4,071,408.06	
14	$8,752,975	$3,952,823.36	
15	$8,498,034	$3,837,692.58	
16	$8,250,518	$3,725,915.13	
17	$8,010,212	$3,617,393.33	
18	$7,776,905	$3,512,032.36	
19	$7,550,393	$3,409,740.15	
20	$7,330,479	$3,310,427.33	
21	$7,116,969	$3,214,007.12	
	$ 534,124,804.24	$440,047,366.81	$94,077,437.43

The "Discounted Costs and Benefits" table presents a comprehensive analysis of both the installation and construction period costs and benefits, as well as the annual impacts, all of which are discounted over the lifespan of the project at a 3% rate. This approach yields both the gross cost and the gross positive economic impact of the PV solar project, providing an overarching view of the project's profitability over its operational life. This table is instrumental in evaluating the long-term value added to the community by the solar project, offering stakeholders a clear perspective on the project's net benefits.

Appendix B: A comprehensive Overview of Inputs for Cost-Benefit Analysis of Utility-Scale Wind Power Project

In Appendix B, the focus is economic feasibility and anticipated benefits of utility wind power installations. Utilizing the JEDI Wind Model and supplemented by regional and national data, this section meticulously calculates initial costs against long-term operational expenditures. It also assesses the economic impact in terms of job creation, value added to the community, and the associated salaries for jobs generated during the project's development and its ongoing maintenance. These financial and economic metrics are discounted over the project's expected lifespan using a 3% rate, culminating in a comprehensive view of total investment costs and the resulting net profit. This analysis presents a clear picture of wind power's role in sustainable economic development, considering both its financial viability and its capacity to contribute to job creation and local economic growth.

Local Economic Impacts - Summary Results				
	Jobs	**Earnings**	**Output**	**Value Added**
During construction period				
Project Development and Onsite Labor Impacts				
Construction and Interconnection Labor	52	$7.77		
Construction Related Services	3	$0.30		
Total	55	$8.07	$8.31	$8.13
Turbine and Supply Chain Impacts	138	$9.00	$29.92	$14.69
Induced Impacts	54	$3.32	$9.56	$5.93
Total Impacts	**247**	**$20,391,089.90**	**$47,795,419.93**	**$28,750,814.61**
		$82,486.27		
During operating years (annual)				
Onsite Labor Impacts	9	$0.56	$0.56	$0.56
Local Revenue and Supply Chain Impacts	18	$1.19	$5.66	$4.20
Induced Impacts	12	$0.81	$2.33	$1.45
Total Impacts	**39**	**$2,556,774.08**	**$8,551,067.32**	**$6,201,951.86**
Notes: Earnings and Output values are millions of dollars in year 2024 dollars. Construction and o		**$66,057.67**		
time equivalent for a period of one year (1 FTE = 2,080 hours). Wind farm workers includes field technicians, administration and				
management. Economic impacts "During operating years" represent impacts that occur from wind farm operations/expenditures.				
The analysis does not include impacts associated with spending of wind farm "profits" and assumes no tax abatement unless				
noted. Totals may not add up due to independent rounding				

The "Local Economic Impacts Summary Results" for the utility wind project leverages the JEDI model to evaluate the economic impacts specific to wind energy development. It focuses on job creation and the associated earnings, both during the construction phase and annually, with values adjusted to 2024 dollars. This table details the gross output and the value added by establishing 300MW wind power facility, emphasizing the comprehensive economic upliftment such projects bring to local communities. By organizing and presenting data on the total impacts of utility wind projects, this table aims to illuminate the broad spectrum of economic benefits, including job generation, enhanced community income, and overall economic vitality introduced by a wind energy investment.

Detailed Wind Farm Project Data Costs		VIRGINIA		
Construction Costs		Cost	Local Share	
Equipment Costs				
Turbines		$135,675,000	0%	
Blades		$42,300,000	0%	
Towers		$49,275,000	0%	
Transportation		$21,572,098	0%	
Equipment Subtotal		$248,822,098		
Balance of Plant				
Materials				
Construction (concrete rebar, equip, roads and site prep)		$14,370,367	90%	
Transformer		$0	0%	
Electrical (drop cable, wire,)		$3,105,724	100%	
HV line extension		$1,563,881	70%	
Materials Subtotal		$19,039,972		
Labor				
Foundation		$3,388,768	95%	
Erection		$4,624,429	75%	
Electrical		$1,331,265	70%	
Management/supervision		$1,806,131	0%	
Misc.		$1,113,784	50%	
Labor Subtotal		$12,264,377		
Development/Other Costs				
HV Sub/Interconnection				
Materials		$4,020,722	90%	
Labor		$1,723,166	10%	
Engineering		$2,144,215	0%	
Legal Services		$522,179	100%	
Land Easements		$0	100%	
Site Certificate		$382,307	100%	
Other Subtotal		$8,792,589		
Balance of Plant Total		$40,096,938		
Sales Tax (Materials & Equipment Purchases)		$0	100%	
Total Project Costs		$288,919,036		

The "Wind Project Data Costs" table offers an in-depth look at the installation costs associated with utility wind projects, including materials, equipment, and labor, presented in 2024 dollars. This section underlines the initial financial investment required to launch a utility wind energy project, emphasizing the critical role of securing federal funding or grants to mitigate these upfront expenses.

Discounted Cost and Benefit along with Project Profit

Year	Cost	Benefit	
0	$ 288,919,036.40	$ 68,186,509.83	
1	$ 9,611,650.49	$ 11,107,841.39	
2	$ 9,331,699.50	$ 11,107,841.39	
3	$ 9,059,902.43	$ 11,107,841.39	
4	$ 8,796,021.77	$ 11,107,841.39	
5	$ 8,539,826.97	$ 11,107,841.39	
6	$ 8,291,094.14	$ 11,107,841.39	
7	$ 8,049,605.96	$ 11,107,841.39	
8	$ 7,815,151.42	$ 11,107,841.39	
9	$ 7,587,525.65	$ 11,107,841.39	
10	$ 7,366,529.76	$ 11,107,841.39	
11	$ 7,151,970.64	$ 11,107,841.39	
12	$ 6,943,660.81	$ 11,107,841.39	
13	$ 6,741,418.27	$ 11,107,841.39	
14	$ 6,545,066.28	$ 11,107,841.39	
15	$ 6,354,433.28	$ 11,107,841.39	
16	$ 6,169,352.70	$ 11,107,841.39	
17	$ 5,989,662.81	$ 11,107,841.39	
18	$ 5,815,206.62	$ 11,107,841.39	
19	$ 5,645,831.67	$ 11,107,841.39	
20	$ 5,481,389.97	$ 11,107,841.39	
21	$ 5,321,737.83	$ 11,107,841.39	
	$ 441,527,775.35	$ 301,451,179.10	
	$ -	$ -	-$140,076,596.25

The "Discounted Costs and Benefits" table for the utility wind project encapsulates both the immediate and long-term economic implications, including installation, construction costs, and benefits, alongside annual operational & maintenance costs, and operational benefits. All figures are discounted over the project's life at a 3% rate to calculate the gross cost against the gross economic impact. This offers insights into the project's overall profitability. By assessing the net benefits over the lifespan of the utility wind project, this table serves as a pivotal resource for understanding the long-term economic implications of the project.

Appendix C: A comprehensive Overview of Inputs for Cost-Benefit Analysis of Soybean Biodiesel Facility

Appendix C explores the prospects of integrating soybean biofuel production into the region's renewable energy mix. Through the application of the JEDI Biofuels Model, it delineates the initial setup and construction costs alongside ongoing operation and maintenance expenses, reflecting a thorough consideration of the economic lifecycle of biofuel projects. This appendix further delves into the economic impact, detailing jobs generated, the value added by the project, and the wages for these roles during both the installation phase and regular operations. By discounting these costs and benefits at a 3% rate across the project's duration, the analysis provides a holistic view of the financial outlay versus the economic return, culminating in a net profit figure. This detailed examination not only highlights the potential for biofuel to diversify the energy portfolio but also emphasizes its role in stimulating local economic development and job creation. One consideration that is left out is the rolea partner would play in terms of having a contractual relationship as a supplier which is necessary with the fluctuating cost petroleum.

Local Economic Impacts - Summary Results				
	Jobs	**Earnings**	**Output**	**Value Added**
During construction period				
Project Development and Onsite Labor Impacts	67	$10.44	$13.63	$11.17
Construction Labor	54	$9.59		
Construction Related Services	13	$0.85		
Equipment and Supply Chain Impacts	116	$9.11	$37.44	$17.37
Induced Impacts	58	$3.78	$10.39	$6.36
Total Impacts (Direct, Indirect, Induced)	242	$23,333,608.34	$61,452,845.61	$34,898,992.25
		$96,440.63		
During operating years (annual)				
Onsite Labor Impacts	3	$0.17	$0.17	$0.17
Local Revenue and Supply Chain Impacts	18	$0.91	$4.28	$2.39
Agricultural/Forestry Sectors Only	12	$0.42		
Other Industries	7	$492,303.86		
		$75,737.08		
Induced Impacts	4	$0.27	$0.75	$0.46
Total Impacts (Direct, Indirect, Induced)	25	$1,354,910.23	$5,203,167.68	$2,068,700.10

Notes: Eamings and Output values are millions of dollars in year 2024 dollars. Construction period related jobs are full-time equivalent for the 3 year construction period. Plant workers includes operators, maintenance, administration and management. Economic impacts "During operating years" represent impacts that occur from plant operations/ expenditures. The analysis does not include impacts associated with spending of plant "profits" and assumes no tax abatement unless noted. Totals may not add up due to independent rounding.

The "Local Economic Impacts Summary Results" for the soybean biofuel plant utilizes the JEDI model to comprehensively assess the economic impact of biofuel production. This includes job creation and associated earnings, both for the construction phase and on an ongoing annual basis, accurately adjusted to 2024 dollars. The table outlines the gross output and value added by a soybean biofuel facility, detailing the significant economic advantages such a project brings to the community. Through a structured presentation of the project's total impacts, it aims to showcase the diverse economic benefits of biofuel production, such as employment opportunities, wage enhancements, and the broader economic enrichment of the community through sustainable energy production.

Cellulosic Ethanol Plant Project Data		Virginia	
	Biochemical	Conversion Process	
Project Construction Costs			
Construction Costs		**Cost**	**Local Share**
Facility and Equipment			
Plant Equipment			
Feed Handling		$933,938	100%
Pretreatment		$1,990,712	100%
Neutralization/Conditioning		$3,227,514	100%
Saccharification & Fermentation		$458,455	100%
Distillation and Solids Recovery		$952,916	100%
Wastewater Treatment		$2,553,155	100%
Storage		$119,066	100%
Boiler/Turbogenerator		$2,468,015	100%
Utility		$294,545	100%
Equipment Subtotal		$12,998,316	
Labor			
Construction Labor		$8,770,973	100%
Labor Subtotal		$8,770,973	
Construction Subtotal		$21,769,289	
Other Costs		$0	
Field Expenses			
Home Office and Construction Fees		$3,906,745	50%
Warehouse		$812,011	75%
Site Development		$859,666	90%
Other Costs (i.e., start-up, right-of-way, freight, etc.)		$2,050,406	90%
Other Subtotal		$9,582,357	
Total		$31,351,645	

The "Soybean Biofuel Plant Data Costs" table delves into the specific costs related to establishing a biofuel production facility, covering materials, equipment, and necessary labor, all calculated in 2024 dollars. This section clarifies the substantial initial capital required to set up a soybean biofuel plant, stressing the importance of acquiring federal funding or grants to address these startup costs.

Discounted Cost and Benefit along with Project Profit

Year	Cost	Benefit	
0	$31,351,645.02	$84,786,453.95	
1	$4,582,004.69	$6,367,065.93	
2	$4,448,548.25	$6,181,617.41	
3	$4,318,978.88	$6,001,570.30	
4	$4,193,183.38	$5,826,767.28	
5	$4,071,051.82	$5,657,055.61	
6	$3,952,477.50	$5,492,287.00	
7	$3,837,356.79	$5,332,317.48	
8	$3,725,589.12	$5,177,007.26	
9	$3,617,076.82	$5,026,220.64	
10	$3,511,725.06	$4,879,825.87	
11	$3,409,441.81	$4,737,695.02	
12	$3,310,137.68	$4,599,703.90	
13	$3,213,725.90	$4,465,731.94	
14	$3,120,122.24	$4,335,662.08	
15	$3,029,244.89	$4,209,380.66	
16	$2,941,014.46	$4,086,777.34	
17	$2,855,353.84	$3,967,744.99	
18	$2,772,188.19	$3,852,179.60	
19	$2,691,444.85	$3,739,980.19	
20	$2,613,053.25	$3,631,048.73	
	$101,565,364.44	$182,354,093.18	$80,788,728.74

This table presents a detailed analysis of both the installation and operational phases of a soybean biofuel plant, incorporating the costs and benefits that are discounted over the project's expected lifespan at a 3% rate. This calculation method provides insight into the gross costs in relation to the gross economic impacts, offering an estimate of the project's net profitability and the sustained economic value it contributes to the community. It serves as a key tool for evaluating the long-term benefits and viability of investing in biofuel technology, emphasizing the project's potential to support local economies while advancing environmental sustainability goals.