Clean Energy Manufacturing in West Virginia: Government Investment Strategies

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Executive Summary

This report assesses government investment into renewable energy manufacturing within West Virginia. Government investment into hydroelectric and wind manufacturing projects are suggested for economic development.

Key Findings

- Wind manufacturing investment should be utilized in Barbour, Grant, Mineral, and Tucker counties.
- Hydroelectric-related manufacturing should be utilized in Fayette, Wood, Pleasants, and Nicholas counties.

Highlights

- West Virginia receives subsidies from the Federal Government to pursue clean energy initiatives.
- Over 50% of West Virginia's manufacturing sector is employed in chemicals, wood products, metals, and plastics.This sector should be utilized to increase manufacturing in renewable energy.
- Manufacturers should be located in proximity to where wind/hydroelectric power is produced. For wind, this is in the eastern highlands region. For hydroelectric, this is in the central and northwestern areas of the state.
- Investment should be utilized with consideration of economic disparate regions of the state.

Introduction

Since 2021, the United States Federal Government has invested significant amounts of money, tax credits, and other incentives in clean energy manufacturing via the American Rescue Plan of 2021; the Infrastructure Investment and Jobs Act; the CHIPS ACT; and the Inflation Reduction Act (IRA), respectively. American Clean Power, a trade association representing the utility industry, estimates roughly “$421 billion in domestic utility-scale clean energy production” has been made in the U.S. since August 2022 (American Clean Power, 2023). According to Canary Media, a media outlet focused on the clean energy transition, this investment is occurring throughout the entire United States (McCarty & Olana, 2023). To date, 78% of these investments are going to Republican Districts; in fact, $787M have been invested in West Virginia’s two congressional districts (Denning, et al. 2024).

Two high-profile examples of this phenomenon in West Virginia are Form Energy’s investment in Weirton and Nucor Steel’s investment in Mason County. From a public policy perspective, these investments are what Bartik (2020) defines as placed-based jobs policies: “state and local government interventions aimed at increasing job growth in a state or local labor market” (p. 100). This paper argues that these types of investments are desperately needed. Over the years, West Virginia’s GDP growth has remained remarkably consistent; examining closer, however, consistency looks more like stagnation. At the county-level, from 2019 to 2022, the median GDP has decreased by 1.6% in 2017-chained dollars (BEA, 2023). Therefore, the Governor should continue these clean energy manufacturing investments throughout the state. However, the location and type of these investments are of utmost importance. Using local indicators of spatial association (LISA) and other spatial analyses, this paper identifies specific counties within the state best suited for clean energy manufacturing investment.

This paper is organized as follows: the first section provides a review of the relevant literature regarding state-level investment as a vehicle for employment and economic growth; the second section describes the data and provides an overview of the code used for this analysis; the final section concludes with a recommendation for the Governor to invest in wind energy-related manufacturing in Barbour, Grant, Mineral, and Tucker counties, respectively; to invest in hydroelectric-related manufacturing in Fayette, Wood, Pleasants, and Nicholas counties, respectively; and, above all, to only invest in counties that have experienced decreasing GDP from 2019-2022, first, and counties with stagnant GDP growth from 2019-2022.

The appendix section details the R code which imports the respective datasets, creates the appropriate variables, and calculates Moran's I test and LISA maps for GDP, hydroelectric, and onshore wind electricity generation by county.

Background/Literature Review

Our analysis of WV is based on Kline and Moretti's (2014) work on place-based policies. Place-based policies target specific geographic areas with government stimulus (such as investment) to revitalize economic activity in the region (p. 630). Utilizing such policies are beneficial to increasing equity in targeted regions and creating productivity spillovers in areas that are closely agglomerated (p. 634). The benefit of moving manufacturing from areas where it is well-established to areas with no manufacturing is limited (p. 657); therefore, equity must be balanced with practicality. In deciding where manufacturing should be located, the economic needs of WV counties are balanced with the need for pre-existing workforce skills.

When investment in a specific industry is targeted, consideration of local circumstances are of paramount importance. One such consideration is the skill and experience of the labor force (Jackson et al., 2020, 24). For this reason, our analysis uses LISA to identify clusters of manufacturing. West Virginia's manufacturing industry is well prepared to undertake the manufacturing of renewable energy products. Over 50% of West Virginia's manufacturing sector is employed in chemicals, wood products, metals, and plastics (Wuest et al., 2018, 2). Previous experience in these industries provides human capital that is needed for renewable energy manufacturing.

Investment should be located in such a way that a connection (or "linkage") is created between manufacturers and the industries they serve. According to Hoover and Giarratani (2020), when inputs and outputs are in close proximity, costs are reduced, increasing the benefit to the region (p. 183). An increased supply of manufacturing services helps to provide "materials, supplies, equipment repair or rental services, or last but not least, specialized manpower to a region" (p. 184). Investment in renewable energy manufacturing should be directed toward increasing the production of renewable energy, producing a *forward linkage*. As a result, our spatial analysis considers proximity to pre-existing wind and hydroelectric power generation sites.

Local Indicators of Spatial Association (LISA) provide a method with which clusters of similar values can be identified (Anselin, 1995, 95). We utilize LISA to determine pre-existing manufacturing activity. Exploratory Spatial Data Analysis is also used to determine regional differences in WV's regional GDP per capita, as in Le Gallo and Ertur (2000).

Subsidies for energy have been commonplace in the United States for the oil and gas industries. Subsidies for companies that promote renewable energy should replicate the pre-existing process if the companies are to be competitive (Harrison, 2015, 847-848). Existing literature asserts that government subsidies are crucial for the renewable energy industry's success. Al-Darraji and Bakir find that investment in the renewable energy industry has a positive impact on GDP growth (2020, 244). A study conducted by Lee finds a high correlation between government investment and renewable energy capacity (2021, 1111-1112). Chinese investment into wind energy projects (including project subsidies) showed an increase in the marketization of companies (Huiming et al., 2014,334).

According to the Department of Energy (DOE), WV currently produces over 90% of its energy using coal. The two highest renewable energy resources – Wind and hydroelectric power – comprise 3.69% and 1.96% respectively (Wind energy). Wind energy is restricted to the northeastern part of the state, and hydroelectric power is powered utilizing rivers throughout the state (Renewable Energy). A report by Schmidt et al. shows that, as of 2023, West Virginia ranks among the top states in the nation for developer interest in hydroelectric projects.

Data Description

This analysis is based on one fundamental idea: the Toblerian law that "near things are more related than distant things," meaning, that certain West Virginia counties are more similar to adjacent counties than they are far counties; and that there spatial clusters – at the county-level — when examining various economic indicators (Tobler, 1969). The data used for this analysis is primarily county-level QCEW data from the U.S. Census; county-level GDP (chained to 2017 dollars) from the U.S. Bureau of Economic Analysis; and county-level energy facility and production data from the U.S Energy Information Agency. To map these data, shape files from the U.S. Census were downloaded and placed into the working directory. Next, the QCEW data, GDP data, and energy data were downloaded from their respective agencies. A for loop was written to iterate through each annual QCEW file, placed it into a temporary table, and bound to the prior year's data. In addition, the data.table library in R is used to save processing time and select only on the appropriate columns.

The QCEW data, Quarterly Census of Employment and Wages, comes from the U.S. Census and describes the annual levels of business establishments, employment, and wages for various NAICS industries. Each file is aggregated to the year-level: 2013-2023. In the original, unfiltered data, there were 39 million rows accounting for all states and industries in the country. The next step in the for loop is to select only for private ownership, state and county-level data, and for the state of West Virginia. This for loop reduced the QCEW dataset down to roughly 6,000 rows.

The county-level GDP data was provided by the U.S. Bureau of Economic Analysis GDP by County, Metro, and Other Areas publication. This dataset has GDP information for each county for years 2019, 2022, 2021, and 2022 and chained to 2017 dollars. This data was downloaded from bea.gov, placed into the working directory, and imported into R.

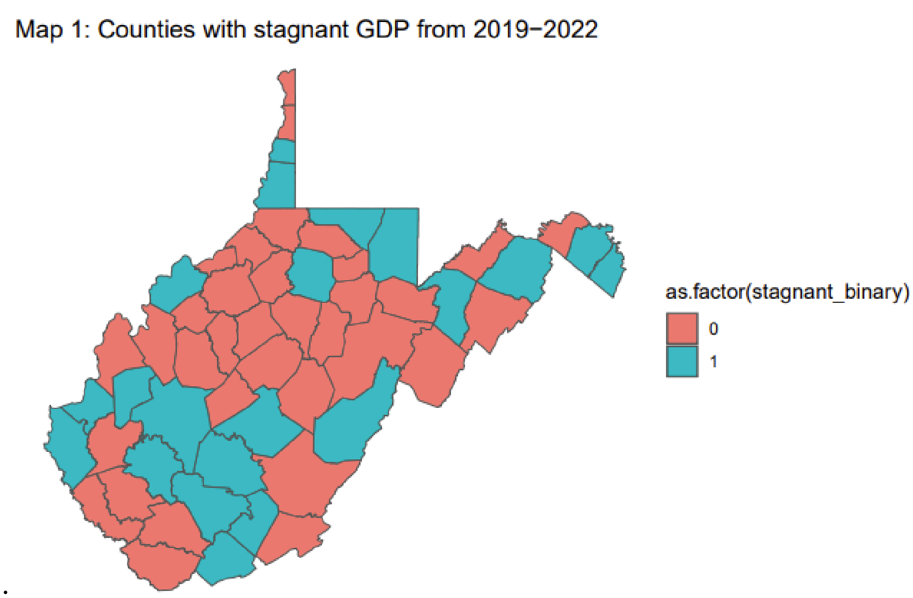
Data from the U.S. Energy Information Administration was downloaded from eia.gov. County-level electricity production data was downloaded from Form EIA-860. This form provides information on utility-scale electricity production throughout the country accounting for roughly 25,000 generation facilities. Once filtered for West Virginia, this brought the number down to 87 generation facilities. There are two technology types at play here: conventional hydroelectric and onshore wind power. To date, there are 37 conventional hydroelectric dams throughout the state and 9 onshore wind turbines.

Analysis

GDP Analysis

This GDP analysis shows which counties of West Virginia are in economically precarious positions. Investment into these counties will assist in their economic revitalization. A binary variable was created to categorize each county into three distinct buckets: counties with increasing GDP from 2019-2022; counties with stagnant GDP from 2019-2022; and counties with declining GDP from 2019-2022. This analysis only pertains to counties with stagnant or declining GDP growth in the examined years.

Map 1 shows that GDP growth identifies counties across the state that are subject to stagnating economic growth, meaning that the growth of the counties were between -0.5% and 0.5% yearly. There is not much uniformity across the state in regards to GDP growth. Counties located in south-central West Virginia are more prone to stagnation, and counties in the eastern panhandle and southern West Virginia are prone to decreasing GDP. Map 2 provides the LISA analysis that shows that there are counties within the state with stagnant GDP surrounded by other counties with stagnant GDP.



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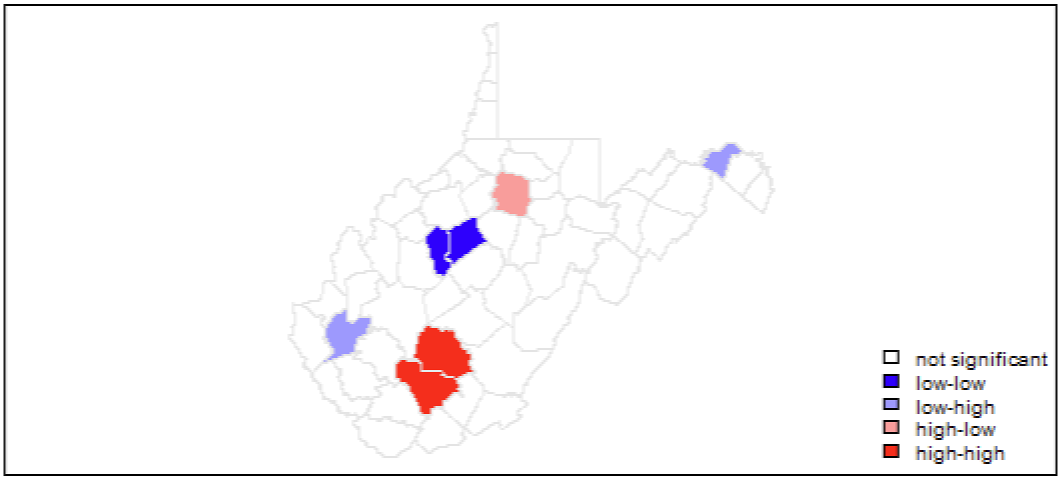
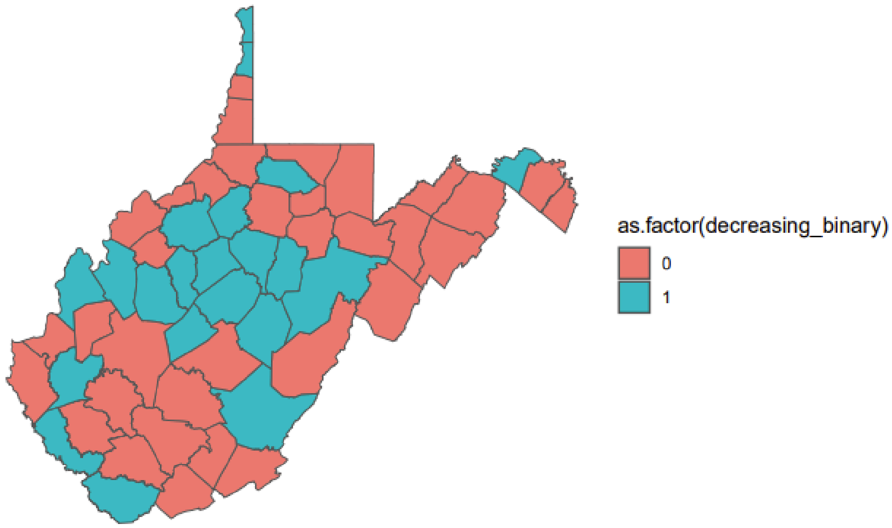
Map 2: LISA Map Clusters of Counties with Stagnant GDP: 2019-2022

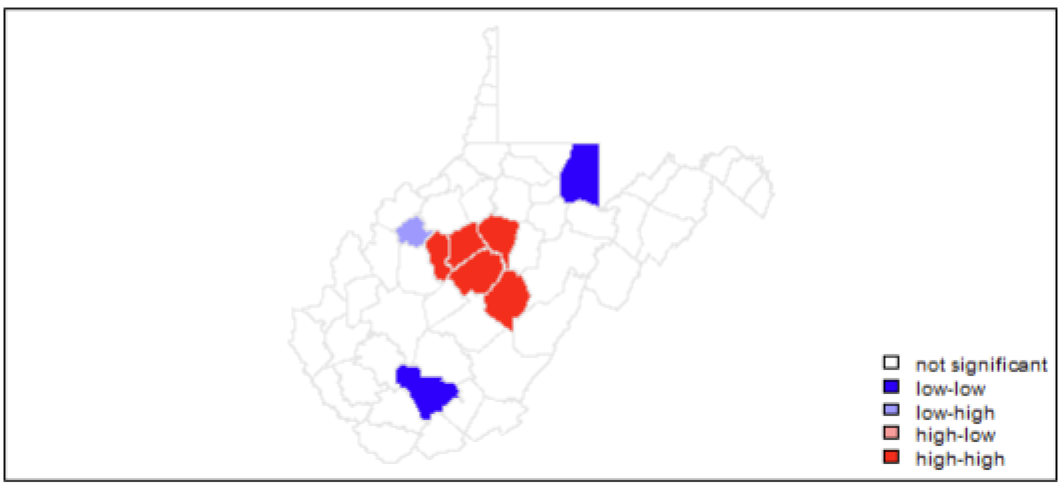


Map 3 details the counties in the state with declining GDP from 2019-2022. Map 4 details the LISA analysis showing that there are clusters of counties in the state surrounded by other counties with declining GDP. The south-central region of the state has seen declining GDP growth from 2019-2022, making them a good choice for this component of revitalization.

Map 3: Counties with Decreasing GDP from 2019−2022



Map 4: LISA Map Clusters of Counties with Declining GDP: 2019-2022

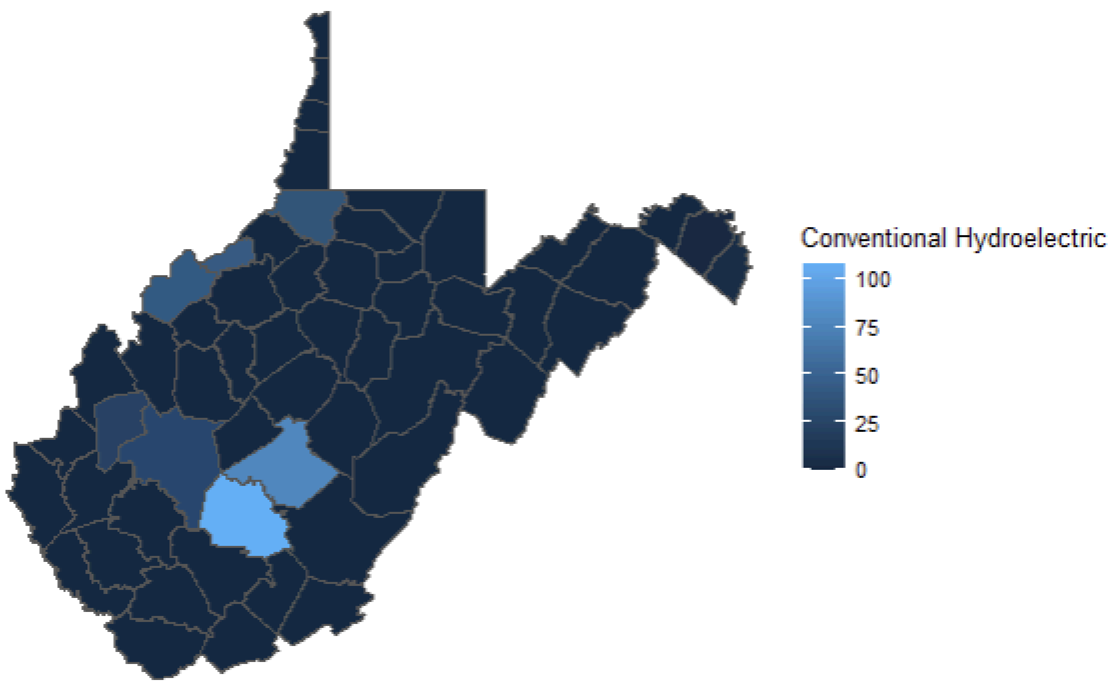


Energy Analysis

In considering where to invest in renewable energy manufacturing, geo-proximity to renewable production centers is imperative to minimize costs. Manufacturing should be located close to where the respective products are being utilized to minimize transportation and time costs.

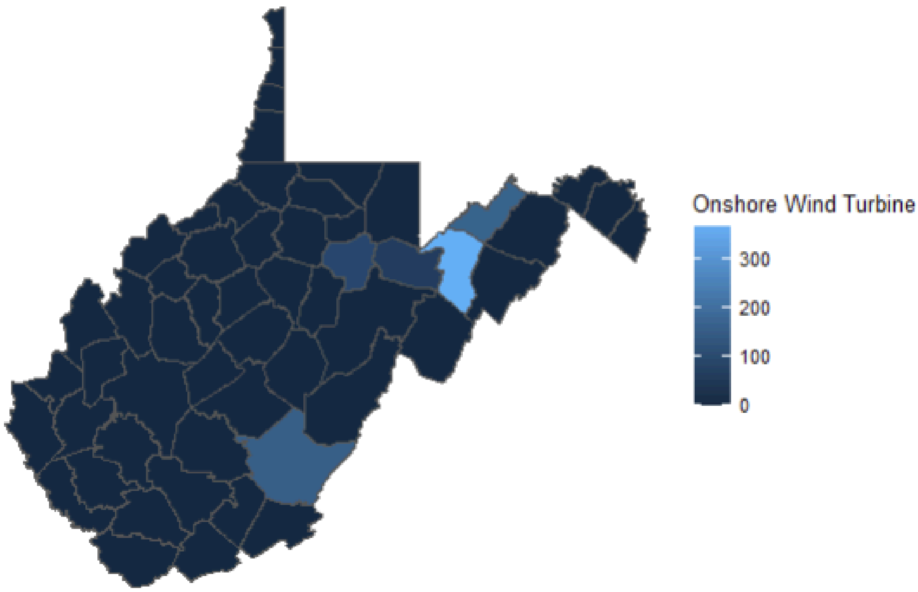
Hydroelectricity production is concentrated visually in the Map 10. The center portion of the state, including the counties of Kanawha, Fayette, Raleigh, and Putnam, have the highest levels of hydroelectric power production. Wood, Pleasants, and Wetzel counties also produce hydroelectric. To minimize costs, hydroelectric manufacturing should be located in proximity to these counties.

Map 5: Counties in West Virginia by Conventional Hydroelectricity Production (MW)



Wind production is concentrated in the eastern third of the state, particularly around the eastern panhandle. Map 12 provides a choropleth map of where wind production is concentrated throughout the state.

Map 6: Counties in West Virginia by Onshore Wind Electricity Production (MW)

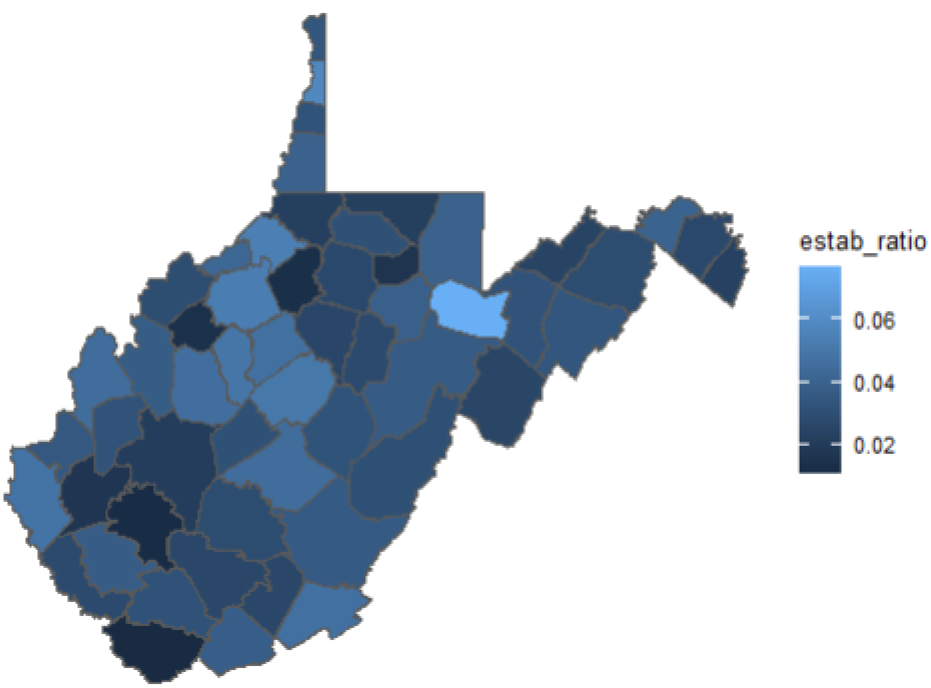


Manufacturing Analysis

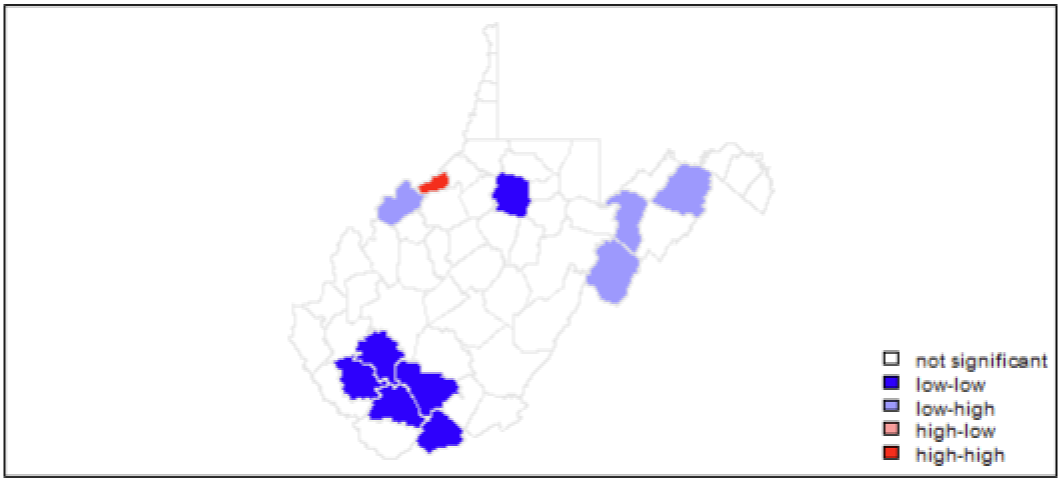
The existence of manufacturing establishments and employment in this industry represents a workforce that is well equipped to respond to new manufacturing in the area. Workers/entrepreneurs can utilize previously earned skills to maximize the benefit of the Governor's investment.

Maps 7 and 8 represent the extent to which manufacturing businesses comprise the overall business of the county. Maps 9 and 10 represent manufacturing employment to overall employment. Both manufacturing establishments and employment are sparse in the southern WV counties. Manufacturing makes up a small proportion of overall activity in the southern counties. This means that they are strong candidates for economic revitalization, but lack the pre-existing skills needed for the industry.

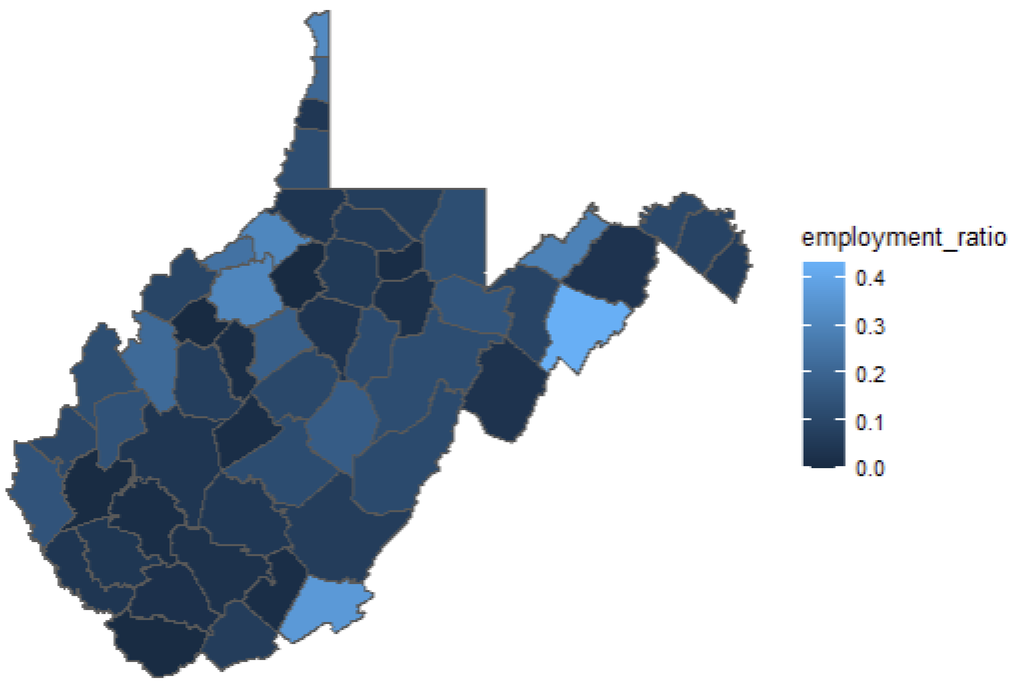
Map 7: Ratio of Manuf Establishments to Total Establishments:2013-2023



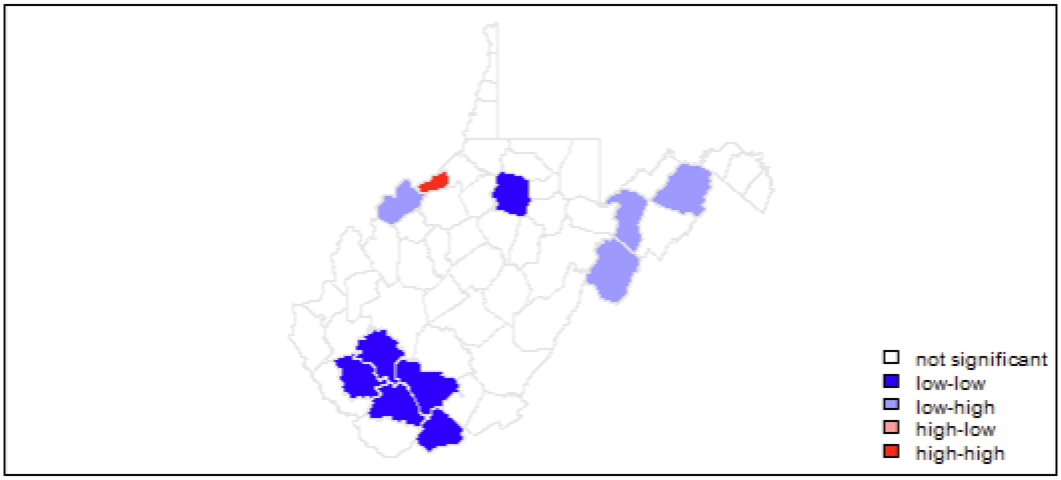
Map 8: LISA Ratio of Manuf Estabs to Total Estabs: 2013-2023



Map 9: Ratio of Manufacturing Employment to Total Emplyoment: 2013-2023



Map 10: LISA-Ratio of Manuf Employment to Total Employment:2013-2023



Conclusion and Recommendation

This paper has provided a theoretical and statistical case for clean energy investment in West Virginia. Specifically, there are two statistically significant, spatial clusters within the state the deserve attention and investment: the spatial cluster of conventional hydroelectric-producing counties – Kanawha, Fayette, and Greenbrier; and the spatial cluster of the onshore wind electricity-producing counties – Tucker, Grant, and Mineral. According to the statistical analyses – the Moran's I test and the corresponding LISA maps – in the appendix, there is evidence of spatial clustering among economic and energy production indicators at the county-level. This analysis has also shown that many of these counties (or adjacent counties) have experienced economic decline from 2019-2022. For example, Fayette and Raleigh counties, respectively, have experienced stagnant economic growth in the examined time period. Further, these same counties are clustered near counties with low manufacturing establishment rates. Our recommendation is as follows: the Governor should invest in clean energy manufacturing facilities, establishments, and employment in/near counties experiencing GDP decline and stagnation. produce renewable energy. This analysis has established a secondary recommendation that the Governor should only invest in areas with stagnant or declining GDP rates and areas with low manufacturing rates.

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