IDENTIFICATION OF FIRMS CAPABLE OF PRODUCING RENEWABLE ENERGY COMPONENTS IN THE KENTUCKY BLUGRASS REGION: A COMPARISON OF REPP STANDARDS CLASSIFICATION USAGE VERSUS SELF-IDENTIFICATION USING ONLINE SURVEYS

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Dedicated to Sara

“Sometimes this life feels like a big old dream
I'm floating around on a cloud inside
When my cloud starts coming apart at the seams
Oh Sarah, that's when I slide”
-lyrics from “Oh Sara” by Sturgill Simpson (2017)

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ABSTRACT

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While the energy field has been primarily dominated by fossil fuels such as coal and oil, there is evidence that renewable energy sources are starting to gain a stronger foothold in the energy market to accommodate growth (Debbage, 2008; Intelligent, 2008; Sterzinger, 2006). This has been the result of greater social concern, as well as tax and other government incentives (Intelligent, 2008; Debbage, 2008). Due to these trends, a growing market opportunity exists for cities and states to increase their renewable energy component production (Intelligent, 2008; Regional, 2013; Debbage, 2008; IPCC, 2014). The primary purpose of this study was to survey existing manufacturers in the Bluegrass Region of Kentucky to obtain information and identify manufacturers who: were currently in the renewable energy market, interested in entering the renewable energy market, or have no interest in entering the renewable energy market. Respondents also addressed potential barriers to the growth of the renewable energy field including workforce development, government policy, and investment capital. A total of 25 companies responded to the survey. Correlation analysis was used and determined that no significant correlation existed between surveyed companies who identified themselves as suppliers of renewable energy components and those companies who were identified as possible suppliers of renewable energy components within the REPP (Renewable Energy Policy Project) standards. This study builds on previous methodology used by Debbage (2008) for North Carolina.

CHAPTER 1 INTRODUCTION

1.1 Background of the Problem

Energy use in the United States has grown exponentially in the past several decades and is expected to continue to grow in the foreseeable future (Intelligent, 2008; Regional, 2013; Debbage, 2008; IPCC, 2014). Fossil fuels dominate the energy field; however, renewable energy resources have started to gain market share in the energy market. This has been the result of greater social concern, government incentives, and increasing technological advances (Intelligent, 2008; Debbage, 2008). Because this is a growing market, the opportunity exists for cities and states to increase their own production of renewable energy components to address environmental concerns using their own respective labor forces and manufacturing capabilities.

This study built upon the methodology used by Debbage (2008) to examine North Carolina's potential renewable energy component manufacturing activity. Debbage's (2008) methodology included the use of standards that had been created by the Renewable Energy Policy Project (REPP) (Sterzinger, 2008) and were based on the North American Industry Classification (NAICS, 2019). These were then used to identify potential renewable energy manufacturing component suppliers based on an industry's six-digit classification number (NAICS, 2019; Sterzinger, 2008). This study, like Debbage (2008), used REPP methodology to identify possible renewable energy manufacturing industries in the Bluegrass Region.

The Bluegrass Region is a microcosm of communities within Central Kentucky, similar to areas of North Carolina that Debbage (2008) identified during his study. However, while Debbage (2008) only identified and categorized the industries, this study differed as companies identified were surveyed to gain greater insight from responses. First, the survey was conducted to allow the researcher to analyze if a relationship existed between firms being identified as a

potential renewable component firm against self-identification as producers of renewable energy components. Second, the survey provided a greater understanding of the regional capabilities for producing renewable components and the willingness to do so based on respondent answers. Finally, the survey asked respondents to self-report potential barriers to entering the renewable component market. A total of 25 companies responded to the survey out of a potential 48, for a 52% response rate.

1.2 The Bluegrass Region

This study was centered on manufacturing industries within the Bluegrass Region of the state. The Bluegrass Region was defined from guidelines established by the Lexington Chamber of Commerce (Regional, 2013) and comprised all of the counties immediately surrounding Fayette (Lexington) county (Regional, 2013). In total the counties included: Fayette (Lexington), Clark, Madison, Bourbon, Scott, Woodford, and Jessamine Counties.

Though the region only consists of 7 of the 120 counties of Kentucky, nearly one quarter of the state's population lives in this region (Regional, 2013). The area is also known for its more progressive politics when compared to other areas of the state; something that may need to be taken into consideration when examining opportunities for expansion into the renewable energy field (Wright, 2013). Other notes of interest include the higher percentage of both high school and college educated workers in the area when compared to other areas of the state (Regional, 2013).

This area serves as a heavy manufacturing area for Kentucky and is located at the center of a 31-state distribution area as well as within a 600-mile radius of a majority of the U.S. manufacturing employment (Regional, 2013). Major cities in this radius include, but are not limited to: Chicago, Indianapolis, Atlanta, New York, Pittsburgh, St. Louis, and Washington D.C

(Regional, 2013). There are two major interstates, I-64 and I-75, which run through the region. This resource has made the area one of the more industrialized areas of the state comparable to the Louisville and Northern KY/Cincinnati regions (Regional, 2013).

1.3 Kentucky: Current Energy Portfolio

Kentucky's current energy consumption consists of 94% of all electricity generated from coal (EIA, 2018), which is not surprising considering the state ranks fifth in the United States in coal production (EIA, 2018). The impact that renewable energy has on Kentucky is currently 6% of all power coming from renewable energy sources which is far lower than the 11% national average (EIA, 2018). Most of the renewable energy base comes from hydroelectric sources because Kentucky has a vast number of waterways, second only to Alaska (EIA, 2018; K. Shanks, personal communication, June 15, 2011). Additionally, due to the low cost and abundance of coal, Kentucky has the sixth cheapest energy prices in the United States (K. Shanks, personal communication, June 15, 2011; Bluegrass Energy, 2018).

Like other states, Kentucky legislature has signed the "25 by 25" policy and has been implementing what Former Governor Steve Beshear deemed the "Seven Point Strategy for Energy Independence" (Intelligent, 2008). Coal is heavily mentioned within three of the seven strategy points. Although the dependence on coal may help Kentucky achieve one of its primary policy goals; being completely energy self-sufficient by 2025 (Intelligent, 2008), long-term ramifications may exist due to the potential negative environmental effects that have long been associated with coal production (Bruggers, 2013).

Katie Shanks (personal communication, June 15, 2011), Assistant Director of Renewable Energy in Kentucky, explained that the state was working with the Tennessee Valley Authority on the Southern Kentucky border to expand hydroelectric power use and is optimistically hoping

to see a 5-6% increase in output in the coming years. Since 2011, the output rose to where 5% of all Kentucky energy came from hydroelectric power (EIA, 2018). Shanks (personal communication, June 15, 2011), however, noted that a major emphasis has been placed on varying methods of biomass, specifically woody biomass in Eastern Kentucky which is heavily forested. This too has risen to be the second largest renewable source for Kentucky (EIA, 2018). Governor Brashear's office released an estimate that Kentucky could potentially harvest 9.18 million dry tons of woody biomass, not including the potential for the cellulosic ethanol that exists for using woody biomass (Intelligent, 2008).

1.4 Statement of the Problem

With more countries, states, and even cities examining methods of using renewable energy sources instead of finite fossil fuels, this research attempted to provide insights into potential renewable energy component manufacturing opportunities for the Bluegrass Region in Kentucky. There is limited research on how to maximize opportunities for Kentucky's renewable energy supply chain using existing industries within the region. The methods used in this study served two significant purposes. First was the identification of possible renewable energy component manufacturers within the Bluegrass Region using REPP standards (Sterzinger, 2008). This had not been completed before. The second purpose was to survey identified companies to provided firsthand records of respondents' views of: their companies' current production output of renewable energy components, future plans for creating renewable energy components, training methods used for shifting to renewable energy component production, and potential barriers to entry into the renewable energy component market.

After analysis of the data provided from the 25 respondents, it was determined that that no significant correlation existed between surveyed companies who identified themselves as

suppliers of renewable energy components and those companies who were identified as possible suppliers of renewable energy components within the REPP (Renewable Energy Policy Project) standards. This survey and resulting data may potentially help local businesses, communities, and the state by providing information to companies in the Bluegrass Region and elsewhere related to identifying potential areas of renewable energy component manufacturing, preferences for workforce training, and continued options for growth into renewable energy production. This study may also assist researchers who plan to conduct similar studies within their own manufacturing communities through replicability whether it be in the fields of renewable energy components or other sectors.

1.5 Purpose of the Study

This study was conducted to serve two purposes. The first purpose of this study was to identify the number of firms in the Bluegrass Region that potentially had capabilities needed to produce renewable energy component parts using the REPP (Sterzinger, 2008) and NAICS (2019) standards. Secondly, this study surveyed manufacturers that were identified in the region to examine if the companies were currently producing renewable components, had plans to do so, or had no interest all. Furthermore, the survey included questions that queried companies to self-report barriers to entry for entering the renewable energy supply chain, and workforce training used and needed for the market. Currently, there are no known studies available that attempted to classify existing Kentucky industries or conducted surveys of industries on willingness to enter the renewable energy component market. Finally, and most importantly, this study was conducted to determine if a correlation existed between being identified through REPP standards as a possible renewable component firm against the data from the self-identifying of producing renewable component parts.

1.6 Research Questions

This research study was conducted to examine several issues regarding the existing manufacturing industry in the Bluegrass Region and the potential renewable energy component market. The primary research question for this study was:

Is there a correlation between firms identified as capable of producing energy renewable components (using REPP standards) with firms who self-identified as capable of producing renewable energy components?

Secondly, a set of follow up questions that this researcher asked were:

For firms identified: 1) Were they aware they were on the REPP list for component parts? 2) What were the current and future needs that the companies believe are needed to grow in the renewable energy field? 3) What were the similarities and differences of firms from varying energy sectors in relation to survey responses?

1.7 Method Overview

This study used the methodology developed by the U.S. Department of Energy funded Renewable Energy Policy Project (REPP) (Sterzinger, 2008). The basis of that methodology was the breaking down of renewable energy technologies into their individual component parts and then cataloging where existing conventional industries were located that could become suppliers within new energy economy. REPP uses the North American Industrial Classification System (NAICS) that is a 6-digit coding system used by every firm in North America to identify products or services that the firm issues (Sterzinger, 2008). REPP identified all of the 6-digit NAICS codes that included activities that could be used in the manufacturing of individual renewable energy components found in solar, wind, biomass, or geothermal production (Sterzinger, 2008).

While Debbage (2008) used Reference USA (2019) to identify firms in North Carolina, this study used the *2018 Kentucky Directory of Manufacturers* (Think, 2018). This directory is a bi-annual report from the Kentucky Cabinet for Economic Development gathered by personal contact with each business listed through surveys. This report has the NAICS codes and specific locations of each firm. The reason for using this directory is because it is Kentucky-specific, unlike Reference USA, and it is updated bi-annually (Think, 2018).

Furthermore, this study expanded on Debbage's (2008) methodology by including a survey that contained questions from several peer-reviewed surveys. The primary reason for this survey methodology was to ensure validity. This study used questions from two previously peer reviewed surveys (MERIC, 2009; IEDC, 2013). The Missouri Economic Research & Information Center (MERIC, 2009) survey was chosen because the questions included a multitude of topics such as demographic information, current strategic plans for producing renewable component parts, and potential training needed for employees in the green energy market. MERIC (2009) also contributed to definitions of green energy production, green building, green manufacturing, green farming, green public administration, and green salvage/remediation. The International Economic Development Council (IEDC, 2013) survey questions were chosen to identify potential barriers related to the renewable energy market which included areas of: finance, state and federal policy, and workforce needs through Likert-scale questioning (1932).

1.8 Definition of Terms

The following terms were used in this study:

REPP - Renewable Energy Policy Project was created by the United States Department of Energy to define growth strategies for renewable technologies based on both the energy market as well as environmental needs (Sterzinger, 2008).

Bluegrass Region - The Bluegrass Region has been defined by the Lexington Chamber of Commerce (Regional, 2013) as an area of Central Kentucky that consists of seven counties: Woodford, Scott, Bourbon, Fayette, Jessamine, Madison, and Clark. The largest city of this region is Lexington (Fayette), which all other counties surround.

NAICS - The North American Industrial Classification System codes are 6-digits long and contain information related to the type of service or product a firm provides. All businesses within the United States have at least one NAICS code. The NAICS was established by the Office of Management and Budget (OMB) and developed jointly by the U.S. Economic Classification Policy Committee, Statistics Canada, and Mexico's Instituto Nacional de Estadistica y Geografia (U.S. Census, 2019).

Green Energy Production (MERIC, 2009) - Green Energy is the conversion from conventional sources of energy to the technology and development of renewable, clean energy sources. The Green Energy industry includes jobs found in energy production and generation activities, power distribution and plant operations, turbine power generation, installation, repair and electronics for windmills, and bio-fuel manufacturing. Examples of job titles can include: Green Engineering Manager, Green Mechanical Engineer, Smart Grid Hardware Engineer, among others.

Green Building (MERIC, 2009) - Green Building uses environmentally friendly materials and methods for residential and non-residential infrastructure. Other aspects of Green Building include: conversion of existing property to lessen negative impacts on the

environment, conversion of sustainable or renewable sources into energy, and replenishment of resources such as water and oxygen. The Green Building industry includes jobs typically found in construction related activities, house shell manufacturing, household appliance manufacturing, design and remodeling services, and remediation services. Examples of job titles can include: Construction Laborers, Construction Managers, Architect, HVAC installers, among others.

Green Manufacturing (MERIC, 2009) - The Green Manufacturing industry includes jobs found in engineering, research and development firms, and across nearly all manufacturing sectors. Jobs in this sector include those involved in the research, development, and production of materials, parts, and final products within the following categories: energy efficiency, renewable energy, and safety. Examples of job titles can include: Production Manager, Quality Control Inspector, Materials Engineer, Industrial Engineer, among others

Green Farming (MERIC, 2009) - The Green Farming industry includes jobs found in agriculture and forestry. Green farming represents jobs in crop production for bio-fuels as well as organic farms and Forest Stewardship Council certified foresters. Other jobs found in agriculture and forestry consist in the areas of: organic/free range food production, forest preservation, and renewable energy resource production. Job titles can include: Farm Mangers, Farm Operators, Federal Organic Farm Specialist, among others.

Green Public Administration (MERIC, 2009) - The Green Public Administration industry includes jobs typically found in local, state, and federal government or in contracts related to government policy. Examples of these activities include the execution, oversight, and operational management of public policy in the areas of environmental

conservation, green building, resource management, and energy. Job titles include: Urban Planning Assistant, Arbitrator, Land Use Planner, City Manager, among others.

Green Salvage/Remediation (MERIC, 2009) - The Green Salvage/Remediation industry includes jobs found in waste management, environmental engineering, chemistry, salvage, and maintenance occupations. Examples of these activities include the process of renewing resources through: material extraction, environmental cleanup, re-use, and product conversion. Job titles may include: Compliance Officers, Cost Estimators, Natural Science Manager, Conservation Scientist, among others.

1.9 Assumptions

Assumptions for this study were that respondents to the survey had an interest in the following: renewable energy, renewable supply chain market, and innovation within the renewable energy component market. It is also assumed that that those who responded to the survey had a comprehensive grasp on the current and future plans related to renewable energy component manufacturing, barriers to entry, workforce training, and basic demographic information. A further assumption was that the methodology created by REPP (Sterzinger, 2008) would be valid to use in the Bluegrass Region to aid in identifying potential firms.

1.10 Delimitations

1. Only the Bluegrass Region of Kentucky was studied due to time and resource constraints.
2. Firms were identified through the *Kentucky Directory of Manufacturers* during the beginning date of 06/04/2018 and ending date of 06/29/2018.
3. To stay closely aligned with the Debbage (2008) methodology, this study only analyzed the potential for an increase in the component market for four renewable energy fields

including: solar, wind, biomass, and geothermal technology. From this the researcher did not research capabilities to other energy markets such as "Clean Coal."

4. The researcher attempted to contact all survey subjects through phone and electronic means; however, a time window of one month was established due to research constraints. The time frame examined was from July 9th to August 9th, 2018.

1.11 Limitations

1. Data collected from the 2018 *Kentucky Directory of Manufacturers* report, though highly reliable, may not be completely accurate due to self-reporting of firms.
2. Firms identified through REPP were contacted for survey responses, however, the 52% response rate is considered high for survey research.
3. The sample size examined was relatively low at 25 respondents.
4. The only statistical analysis run was a Fischer's Exact Test because of the small response set. Additional testing may have been inconclusive.
5. Participants may have been limited in the information they were able to provide during the surveys.

1.12 Researcher Bias

It is relevant to report a potential issue of researcher bias related to the study. The researcher is from the Bluegrass Region and chose this location to study because of his familiarity with the area. The researcher also stated in the letter addressed to potential respondents that the background of the researcher included living in the Bluegrass Region (Appendix B). A possibility did exist that respondents chose or chose not to disclose information because the researcher was from the area. However, respondents were assured of anonymity of

the survey and it is believed that survey respondents were free to answer questions without being identified. Another possibility is that the researcher's personal interests in this particular subject may have had some impact on the outcome of the study. Every effort was made to use methodologies that would minimize the opportunity for researcher bias to be an interference.

1.13 Significance of the Study

This study has the potential to have ramifications for Kentucky and the Bluegrass Region as well as other affected stakeholders (manufacturing plants, employees, local government officials, etc.). By identifying and surveying firms that were producing components that aligned with REPP standards (Sterzinger, 2008), stakeholders may have entertained several options depending on their participation in the industry. For example, companies identified may not have considered entering into the renewable component market, but due to notification as being a possible entrant by participating in this survey, they may have shifted their strategies towards renewable component manufacturing. Stakeholders such as government officials may have read similar reports and created plans to increase the renewable energy component market through influential tax breaks and other incentives. Several states, such as Tennessee, have used similar data reports for such measures in creating legislation and policy (Sterzinger, 2008; Tracz & Bailey 2010).

This study also aids in the addition of research to a limited field. Similar studies (Sterzinger, 2008) have been conducted using methodologies similar to Debbage (2008) in relation to the NAICS codes and manufacturing identification. However, to this researcher's knowledge, no current study has attempted to identify and survey firms to gauge awareness of and plans for entering the renewable energy market. Furthermore, no study has examined

possible relationships that may exist between the identification of a firm in reference to capability and willingness of entering the renewable energy component market.

For Kentucky, only one other similar study was found (Glasmeier, Feingold & Guers, 2007) which examined the Appalachian Region of the state. Two counties in this study were included in the Glasmeir, et al. (2007) study, however due to the study's date and lack of company identification, it was determined that this was not a replication of that study. It is feasible that several potential firms may have entered and exited the market since the Glasmeier, et al. (2007) study was completed. This current study may be of interest for companies related to the renewable energy field that may be examining, expanding, or opening new facilities in the area.

1.14 Summary

Increasing concern for the environment based on finite energy sources has led to greater exploration into the production of renewable energy technologies. From this, the potential exists for states and communities to not only reduce their own carbon emissions through adoption, but also to provide economic opportunities for residents based on the expected growth of such markets. One way of tapping into this growth may be through the examination of current manufacturing industries in the Bluegrass Region using the REPP (Sterzinger, 2008) methodology that Debbage (2008) used, and expanding research through the surveying of firms for awareness regarding possible barriers of the renewable energy component market. To this researcher's knowledge, no similar study has been published that attempted to identify a correlation between identification of firms through REPP (Sterzinger, 2008) against self-reporting of capabilities in production of renewable energy component parts.

CHAPTER 2 LITERATURE REVIEW

2.1 Introduction

The government's increase in incentives, along with the rising costs of the finite supply of fossil fuels, more emphasis is being placed on increasing usage of renewable energy sources (Debbage, 2008; Regional, 2013; Kamal, 2010; IPCC, 2014; Sterzinger, 2008). The United States has implemented goals for 2020 and beyond in reducing carbon emissions and the environmental footprint of humans (Intelligent, 2008; Regional, 2013). Furthermore, many states have approached and adopted legislation to meet local demands and goals related to renewable energy usage. One such state is Kentucky, which has developed a 7-point plan on decreasing fossil fuel dependency with the intention of being self-sufficient by 2025 (Intelligent, 2008; Tracz & Bailey, 2010). The potential exists for the state's economy to be impacted by increasing opportunities to develop components that can be used in the production of renewable energy technologies.

2.2 Methodology

To conduct meaningful research a broad array of topics was explored. These topics included: government policy on a federal and state level, barriers to innovation, renewable energy guidelines, renewable energy supply chain, the coal industry, survey reliability and measurement through different media, surveys of green industries, and lastly the Bluegrass Region. Research was gathered using Google searches, academic databases (EBSCO and Google Scholar) and government websites and interviews. Words included during searches included: Kentucky coal economy, renewable energy markets, increasing renewable energy, 20/20 goals, Kentucky renewable energy policy, U.S. Department of Energy, survey, green

energy, supply chain, survey results between internet, phone, and mail, survey validity, NAICS and REPP.

2.3 Discussion

2.3.1 Federal Policies and Renewable Energy

The United States federal government issued several policies over the past decade in order to address two primary issues: first, to catch up with their European counterparts whom took earlier measures to adapt renewable energy sources within their power grid (Kamal, 2010) and second, to address the growing demand of energy consumption from fossil fuels that the country is currently facing (Kamal, 2010; Balat, 2006; Blueprint, 2011). These policies addressed energy issues in both transportation as well as the electrical grid as a whole.

One of the biggest policy shapers regarding renewable energy for the United States was the "25 by 25" campaign that started as a grassroots movement and was later adopted by several states along with corporations and eventually passed into legislation (Blueprint, 2011). The focus of this policy was that, by the year 2025, America will cut its dependence on foreign oil by a third as well as supply at least 25% of its energy grid from alternative energy methods (Blueprint, 2011; Intelligent, 2008). A method of accomplishing this goal listed in the action plan for the program is to bring new technologies to the market and available to consumers (Blueprint, 2011).

Other government policies related to the "25 by 25" legislation can be seen in both the Energy Policy Act of 2005 and the American Recovery and Reinvestment Act of 2009 (Tracz & Bailey, 2010). The Energy Policy Act of 2005 provided several incentives for consumers and businesses to use renewable energy sources, specifically solar energy (Holahan, 2008). This act increased funding related to research in the renewable energy field (Holahan, 2008).

Kamal (2010) offered up another reason why the exploration of alternative energy and use was important; security. Kamal (2010) stated the current energy infrastructure of the United States was both an environmental and economic weakness that could be exploited if not improved. Kamal's (2010) main reasoning was that the dependence on fossil fuels could cripple the United States economy as the recession of the late 2000's showed.

On August 3rd, 2015 President Obama and the EPA disclosed new U.S. regulation to cut carbon dioxide emissions from the 2005 baseline to 32% by 2030. This act was titled the Clean Power Plan (Spina & Ramadevanahalli, 2015; Mooney, 2015; Siciliano 2015). This legislation targeted setting state specific standards from fossil fuel-fired power plants (Spina & Ramadevanahilli, 2015). The plan was labeled as being the first ever federal limitation on carbon emissions and was formulated under the EPA's authority due to Section 111(d) of the Clean Air Act (Spina & Ramadevanahilli, 2015).

States under this act had until September 2016, to submit a final plan or an initial plan with an extension request due by September 2018, on reducing carbon missions (Mooney, 2015). States that refused to comply with setting standards face having standards set for them by the Federal Government (Spina & Ramadevanahilli, 2015). It is important to note that the Clean Energy Incentive Program is designed to encourage adoption and investment in energy efficiency projects and drive faster renewable energy deployment at the state level (Spina & Ramadevanahilli, 2015).

Upon the plan's original introduction, Senator McConnell expressed displeasure and planned with the GOP to overturn the bill (Siciliano, 2015). Kentucky Governor Matt Bevin expressed that the state would not comply and that he would not submit a plan. (Kentucky, 2015). Predictions originally showed implementation would reduce coal demand by over 20%

and potentially raise electric prices while decreasing the reliability of the energy grid (Harris, 2015; Kentucky, 2015). Kentucky was initially required to reduce its carbon emissions to 77 million tons by 2030, but under new guidelines that was increased to 63 million tons (Sadasivam, 2015).

Other criticisms from opponents of the plan included single emissions limit for each type of fossil fuel plant. For example, a coal plant in Kentucky was expected to achieve the same amount of emissions as one in New York (Sadasivam, 2015). Kentucky became the first state to pass legislation restricting the Clean Power Plan and prohibiting the state from proposing a solution that shifts the energy mix away from coal or from also increasing the generation of renewable energy (Sadasivam, 2015). Kentucky was also one of 15 states to have filed a lawsuit against the federal government for potentially overstepping their boundaries in creating the Clean Power Plan (Harris, 2015; Reuters, 2015). Currently, President Donald Trump has called for a review of the plan (EPA, 2018) and many states such as New York and Massachusetts have filed lawsuits blocking the EPA from fully repealing the Clean Power Plan (Scott, 2019).

The Clean Power Plan may have provided the foundation for the international agreement that the United States entered in December of 2015. The Paris climate agreement was a pact agreed upon by 195 countries, 187 that are responsible for 95% of emissions (Leber, Merchang, & Belenky, 2015), to cut greenhouse gas emissions to pre-industrial levels that to limit the global average temperature by two degrees Celsius by 2030 (Kinver, 2015). Under President Obama, the United States had pledged to reduce their emissions from 26 to 28 percent below 2005 levels by 2025 (Leber, et al., 2015). The two degrees is important to note as this has been the scientific agreement where the level of warming could create dangerous climate change that could threaten life on earth (Kinver, 2015).

Some criticisms existed from this agreement due to target rates for each country are voluntary and not legally binding (Aschwanden, 2015). The only aspect of the agreement that is legally binding is for countries to meet every five years to report their emissions and create new pledges (Leber, et al., 2015). As with the Clean Power Plan, leaders in Congress also threatened to reverse the agreement citing the belief the agreement is illegal and could threaten domestic jobs and economic growth (Newsmax, 2015). In 2017, President Trump withdrew from the agreement citing the before-mentioned reasons why it would not be in the United States best interests to stay in the agreement (Mooney, 2018).

Another criticism of the Paris climate agreement was due to some scientific simulations predicting the world would stay below the 2-degree threshold with proposed emissions controls in place. (Aschwanden, 2015). That threshold would require leaving 80% of global coal, 50% natural gas, and 33% of oil untouched until at least 2050 (Aschwanden, 2015). However, one business, Ford, announced in 2015 that they planned to invest $4.5 billion in electric vehicles to meet the new auto emission standards (Newsmax, 2015).

2.3.2 Kentucky

The focus of this study was to build upon the second principle of the 7-point plan from Kentucky's strategy for energy independence, "Increase Kentucky's Use of Renewable Energy" (Intelligent, 2008). The strategy for achieving this goal from the Intelligent (2008) document was to examine potential opportunities that may exist in component manufacturing of renewable energy sources: solar, wind, biomass, and hydroelectric through identification and surveying firms. However, the document itself did not examine the economic market that production of these energy markets could produce for the state except to state that the potential exists in the

hydroelectric and biomass market due to existing infrastructure (Intelligent, 2008; K. Shanks, personal communication, June 15, 2011).

2.3.3 Barriers to Innovation

One barrier of the renewable energy market in Kentucky may be that the renewable energy market is perceived as a threat to other existing energy markets. The coal industry has been noted to view renewable energy expansion as a threat to its longevity (Bruggers, 2013). Concerns have caused the coal industry to use their political affiliations to energy legislation within the state (K. Shanks, personal communication, June 15, 2011; Bruggers, 2013).

Another barrier may come from those who could benefit from using renewable energy sources. Kentucky is primarily a manufacturing state due to its cheap energy prices due to a large supply of coal (K. Shanks, personal communication, June 15, 2011; Intelligent, 2008). However, when the state examined mandating an increase in prices to industries that did not receive any power from renewable energy sources, legislation was halted because manufacturers created an uproar with their congressional counterparts (K. Shanks, personal communication, June 15, 2011). It is because of instances like this that Kentucky may face challenges in widely adopting renewable energy technology.

2.3.4 Coal in Kentucky

Though the "7 Points of Independence" (Intelligent, 2008) had an emphasis on maintaining and possibly increasing the labor force of the coal industry, the reality is that in recent times the industry has experienced several layoffs and a decline in the workforce (Bastasch, 2013; Bruggers, 2013; Mcllmoil & Hansen, 2010; Wright, 2013). Over 3,000 miners have lost their jobs since early 2012 (Wright, 2013) with a recent layoff being over 10.6% of Eastern Kentucky coal mine workers during the second quarter of 2015 (Coal, 2015). Since

2011, more than three dozen coal companies have filed for bankruptcy (Harris, 2015). One of the casualties of this has been the last union mine, Patriot Coal, which closed leaving 400 employees displaced (O'Connor, 2015). Shares in coal companies have also fallen more than 90% from 2014 to 2015 with a slow recovery in sight due to the low coal prices and high debt coal companies have taken on over the years (Loh, 2015).

A difference in opinions exists regarding why there were such large layoffs in a relatively short time. Some believe that the majority of these layoffs stem from tougher government policy and EPA regulations against the industry (Rogers, 2013; Bastasch, 2013). Others point to reasons such as an increase in renewable energy portfolio in the state and competitive pricing in the natural gas market led to the decline in the coal market in the state (Bruggers, 2013; Wright, 2013). Until April 2015 coal was responsible for over 50% of electric generation but has now been surpassed by natural gas (Harris, 2015). Between 2008, when the "7 Points of Independence" strategy was written, and 2013, employment in the coal industry fell nearly 50% from 17,000 workers to around 7,500 (Bruggers, 2013).

2.3.5 Previous Studies

Although this study relied heavily on the methodology used by Debbage (2008) to identify potential firms for the renewable energy component market in the Bluegrass Region, there are several other studies that have examined the potential for increasing and identifying firms for a renewable energy market. In developing a framework for this study, several renewable energy standards and reports of other states were researched.

Debbage (2008) was the initial study that was found to link existing manufacturing industries to that of individual components with potential use in the renewable energy field. Debbage (2008) noted in his study that although a difference may exist between the NAICS

codes and what firms were currently producing that may benefit the renewable energy supply chain, it could not be understated that firms meeting the 6-digit code would be more prepared in adapting their practices to specific components if they chose to do so. In his findings, Debbage (2008) was able to examine the state of North Carolina and concluded that the potential market that could be expanded into renewable energy technology consisted of over 1,300 firms and included over 61,000 workers.

Though Debbage (2008) was instrumental in creating a methodology and in-depth analysis of using REPP and NAICS for understanding a state's renewable energy supply chain, there were some ways the study could have been improved upon. One example was that upon identification of potential firms, Debbage (2008) could try to gather data from identified firms or potentially ask them about their willingness to enter the market. Surveying was noted as being a tool to examine if outside identification mirrored self-reflection of the manufacturing of renewable energy component parts.

Debbage (2008) was instrumental in tying together REPP and NAICS to gain understanding of the renewable energy market; others have also used this or similar methodologies. One study focused on the solar and wind energy supply chain in Michigan. In this study it was concluded that Michigan has 121 solar power supply chain businesses and 120 wind power supply chain businesses with 50 businesses serving both markets (Craig, Learner & Gray, 2011). Though this study noted several reasons why Michigan was viable for the component market, which ranged from favorable policy and incentives to an industrial manufactured base (Craig, et al., 2011), the authors never explicitly stated how the businesses were identified. Even after have noting that observation, this study was worth mentioning due to

a focus on renewable energy components along with the using of old-line manufacturing companies to make equipment for the growing renewable energy market.

A report by the Texas Office of the Governor (Office, 2014) focused on the renewable energy industry in the Lone Star State. This study identified around 1,400 firms and 102,000 employees in the state that were either directly or indirectly in the renewable energy market (Office, 2014). Like the Michigan report (Craig, et al., 2011), the process for identifying potential firms and markets was never clearly identified, nor was a table of firms presented. However, there were several interesting points that this study addressed, specifically the fact that foreign companies had invested in renewable energy operations in the state. Another way the state has increased the market was by the creation of the Texas Emerging Technology Fund which has awarded over $46 million since its inception in 2005 to renewable energy related projects (Office, 2014). This is an example that may be important to Kentucky because Texas, like Kentucky, has been known primarily as a leader in fossil fuels but is showing interest in the investment of alternative energy sources.

A state that shares a similar characteristic in energy production to Kentucky is the state of Kansas. Like Kentucky, Kansas receives most of their energy from coal production at 75% (Church & Jacoby, 2008). However, a study by the American Council on Renewable Energy (ACORE) used several factors in trying to predict the future of the renewable energy market in the state. The methodology used for this study was based on energy projections and how increased usage could be offset by the incorporation of renewable energy sources (Church & Jacoby, 2008). The use of REPP component parts was incorporated on a limited basis to claim that the state had 11,491 jobs that could be tied to the wind energy market (Church & Jacoby, 2008). As with other studies the numbers given were mainly based on projected outputs; the data

presented wasn't extensive regarding individual firms or counties. However, it was one of few studies about NAICS and component manufacturing.

Perhaps one of the most in-depth studies of other states was in relation to a study on Indiana by George Sterzinger (2008), whom was one of the founders of REPP. In his study of Indiana, Sterzinger (2008) noted that Indiana lost over 77,000 manufacturing jobs between January, 2001 and July, 2007 and called for a national commitment to the renewable energy market in order for the market to both be enlarged and succeed. Sterzinger (2008) used a job calculator that calculated the number of direct jobs resulting from renewable energy development under legislation and other programs to accelerate renewable energy development. This was in addition to using NAICS codes to identify firms that are producing components that can be used in the renewable energy market based on REPP requirements. From this formula Sterzinger (2008) identified approximately 1,321 firms in Indiana that could supply component parts, which would affect over 39,000 jobs.

This study also addressed the possibility of bottlenecks in the component supply chain. This was analyzed by data on the incremental annual demand for components as a percent of the available unused industrial capacity for each of the major industrial sectors (Sterzinger, 2008). In projections, Sterzinger (2008) also tried to consider climate stabilization by using a wedge analysis developed by Pacala and Socolow (2004) where electricity generation would be responsible for one wedge.

Like Debbage (2008), Sterzinger (2008) examined a county-by-county analysis of potential firms with a breakdown of the four major renewable energy sectors that may be related to this research. However, although a county breakdown was shown, again no individual firms were listed. Sterzinger (2008) also noted advantages and disadvantages of using the NAICS 6-

digit code. The fact that the code was standard for North America was listed as the distinct advantage, although the issue of the code possibly being too broad was listed as a main disadvantage (Sterzinger, 2008).

This disadvantage was important to note; in this researcher's opinion that this could mean that classification does not necessarily mean capability or willingness, something that this study addressed. It was also mentioned (Sterzinger, 2008) that a company that is making something similar to the required component has a distinct advantage over a company that is trying to start from scratch and enter the market. This may strengthen the case of identifying and using existing manufacturing industries for states and cities that want to expand their local renewable energy supply chain.

2.3.6 Previous Surveys

In using a survey for this study, peer research was conducted regarding the validity of surveys and formats of surveys that may be presented. Areas explored were the response rate statistics of the methodology, possibility of researcher bias, and ease of use. From the research conducted an online survey was selected as the ideal method. This was due to the ability to reach the audience selected, cost effectiveness, limitation of researcher bias, ease of usage for respondent, and ability to analyze data from the transfer of a Qualtrics© survey to SPSS©. In addition to an online format, other formats that surveys may be conducted with included: telephone, mail, and face-to-face.

Several research articles regarding the pros and cons of distributing surveys through online methods were reviewed for applicability (Wiebe, 2010; Braunsberger, Wybenga, & Gates, 2007, Mazzarello, Clemons, Graham, & Jacobs, 2014; Chang & Krosnick, 2008). Overall, researchers were clear about the ease of use that online surveys present for researchers

(Mazzarello et. al, 2014, Wybo, 2010; Braunsberger, et. al, 2007; Chang, Krosnick, 2008). Among these was the ease of Internet surveys in allowing researchers to contact a broad demographic in a relatively inexpensive way when compared to the traditional method of surveys by mail. One article (Braunsberger, et. al., 2007) noted the average mail survey cost was around $30 per survey in comparison to online survey cost which averaged $14 per survey. This cost was associated with materials used and time spent creating the surveys. However, it should be important to note that of the articles reviewed, the cost for online surveys should be expected to be cheaper as technology has grown at a fast pace from the economies of scale.

Another positive that was presented regarding online surveying tools was regarding researcher bias removal that existed in comparison to phone surveys (Bruansberger, et. al., 2007). It was noted that through phone surveys, the surveyor's dialogue and attitude could play a role in causing respondents to respond a certain way. For instance, a surveyor may be more enthusiastic in conveying one answer over another, which may influence the respondent to choose that answer (Bruansberger, et al., 2007).

In a differing opinion, Chang and Krosnick (2007) wrote that they viewed this attribute as a positive over online formats. Their reasoning was that surveyor engagement could cause respondents to continue the survey until completion, unlike online surveys where the respondents could stop at any giving time. Chang and Krosnick (2007) also remarked that unlike mail and online surveys, phone surveys have an advantage because the respondent does not have to be literate to answer questions as the surveyor can read the question and the answers and give clarification if needed. Though both articles were intriguing, this researcher's opinion is that it ultimately the surveyor's attitude may lead to bias. Because of this possibility, the online survey method would be preferable in administering the survey to help minimize possible bias, as well

as providing the respondents an opportunity to respond during opportune times related to their schedule.

In relation to validity, Mazzarello, et. al. (2014) documented that the response rates were lower for online surveys in comparison with mailed surveys. Their study showed the response rate to be 36% for online surveys compared to the 59% of mailed surveys. However, later in the same article (Mazzarello et. al, 2014) wrote the best approach for response rates shown was the total design approach, which would be an email survey along with personal contact and follow-up afterwards.

An integral part of this study relied on the surveying of firms identified by REPP. To have a proper survey method, research was conducted to find similar studies involving researchers surveying industries in the green energy or renewable energy field. One interesting study was that of the Florida Agency for Workforce Innovation (AWI) (2009) which broke down the survey methodology and findings of several states. These states included the following: Washington, Michigan, Oregon, Minnesota, and California. The varying states and survey methodologies allowed the researcher to entertain multiple ways one could attempt to reach firms and understand their place in the renewable energy market.

Washington researchers conducted their surveys by mail and followed up no responses with phone calls (AWI, 2009). The sample size for their survey was 17,000 from 27,000 with a criterion being a firm must have at least 200 employees. They were able to garner a 61% response rate; however, this survey did not seem very informative. The survey questions were focused on job titles, numbers of workers, and employment status. The surveys for Michigan (49% response rate) and Oregon (45% response rate) were also conducted in a similar manner. One difference in regard to the Oregon study was that questions were slightly more in depth by

the inclusion of salary ranges and educational requirements (AWI, 2009). The shortness of the surveys may have played a part in the high response rate.

The other two states from this study, Minnesota and California, were conducted in what may be considered more in-depth formats. Minnesota gave a great introduction to firms regarding why they were selected to be interviewed, and also built on asking previous questions, lines of business, and several open-ended questions. California broke down businesses in an acronym GREEN format focused more on renewable energy usage instead of industries joining the market. Unfortunately, response rates were not available from these two surveys.

One of the most in-depth surveys found was from MERIC (2009). This was a Missouri based study, one of Kentucky's neighbors and potential competitors for growing a renewable energy supply chain. The MERIC (2009) study identified around 5% of Missouri jobs as green jobs and broke those down into six areas: energy, manufacturing, building, farming, salvage, and government. This study did use NAICS to an extent, but not in identifying firms to survey. The survey determined there were around 131,000 green jobs, with around 17,000 in manufacturing in Missouri. What made this survey stand out among others was the emphasis the researchers placed on trying to identify barriers that prevented firms from going into the renewable energy market. Due to the relevancy of the questions used, some questions from this survey were selected for this research study.

Though the sample size was around 4,000 from an almost 19,000 sample sizes and a high response rate (71.2%), questions were raised regarding some elements of the survey methodology. For example, the most glaring due to the survey being based entirely on a phone survey meaning there lies the chance some firms were not contacted for not having a phone, or not answering the call (though noted that the researchers did attempt multiple times at no-

answers). Furthermore, the phone survey lasted around 10 minutes long, which may not have been convenient for those that answered as respondents were answering questions on the spot, and some questions may require a more in depth understanding of the business which could have led to potential incorrect data.

Lastly, the survey from the International Economic Development Council (IEDC) (2013) was examined regarding methodology. In this study, researchers created a nationwide study focusing on two surveys, one for economic developers and the other for renewable energy businesses. Though a response rate was not found, the survey did use a stratified random sample from firms found in solar and wind associations (IEDC, 2013). This survey also broke down renewable energy businesses into sectors (wind, solar, biofuel) and compared those against each other to find similar and differing attitudes (IEDC, 2013). Furthermore, the survey contained questions regarding policy and impact on promoting growth, as well as questions regarding barriers to entry. An important observation that was different from other surveys was that this study was contained questions related to the significance that policy can have in developing economies and markets in the field. This was the second survey methodology that was adapted into the present study.

Fisher's Exact Test

Due to only having 25 survey responses, an adequate way of interpreting and analyzing results for this study was a Fisher's Exact Test. Fisher's Exact Test is used when the number of observations obtained for analysis is small and the need to consider all possible cell combinations that would result in marginal frequencies is warranted (Bower, 2003). Bower (2003) indicated that a small number of observations is less than five values in cell combinations of a contingency table. Raymond and Rousset (1994) expressed that Fisher's computes the exact

value of type-one error probability for rejecting Ho is by summing probabilities of all tables that have the same or smaller probabilities and with same rows and columns. Fisher's exact test in small samples such as this study has shown to be more accurate than the chi-square test (Connelly, 2016).

2.3.7 Kentucky and Renewable Markets

There have only been two studies that have extensively tried to examine the potential of renewable energy careers in Kentucky. The study by Tracz and Bailey (2010) focused primarily on workforce development within the state for renewable energy development. From their viewpoints, there were three primary reasons why the state of Kentucky had potential for a clean energy economy (Tracz & Bailey, 2010). The first reason listed was due to the state having an energy efficiency gap which could create opportunities to save money on electricity bills and create jobs in the construction and retrofit sectors because the current energy grid, primarily coal, wasn't entirely an efficient process (Tracz & Bailey, 2010).

Secondly, the state's natural landscape and conditions present opportunities for production, for example the heavily wooded areas of Kentucky may be ideal for biomass (Tracz & Bailey, 2010). Lastly, the reason that strongly pertains to this research is that the manufacturing base in the state creates opportunities for job retention and creation with a transition to a renewable energy component part and system manufacturing (Tracz & Bailey, 2010).

The research found did not provide an in-depth description of the manufacturing system and how it could play a key part in the development of component parts (Tracz & Bailey, 2010). It seems that the conclusions that Tracz & Bailey (2010) draw on is based on projections from other agencies, particularly a report from Pew Charitable Trust which noted the state had a

growth rate of 3.6% between 1998 and 2007 for all jobs, but the number grew to 10% in clean energy economy jobs (Tracz & Bailey, 2010). It may be said that unlike other methods presented which identified firms, this study may have issues with firm conclusions since individual firms in manufacturing were not identified. However, it is worth noting that in order for the market to succeed in Kentucky a heavy emphasis must be placed on training the workforce and the stat was giving that many jobs in the state are labeled as middle skill work which requires more than a high school degree but less than a 4 year degree while the majority of the Kentucky workforce is primarily lower skill workers so the gap must be closed for the state to be competitive (Tracz & Bailey, 2010).

One study that examined opportunities of the renewable market in Kentucky focused on the Appalachian Region, which is in Eastern Kentucky (Glasmeier, et al., 2007). As with Debbage (2008) and Sterzinger (2008), this study (Glasmeier, et al., 2007) used the 6-digit NAICS codes for the region in addition to citing a 2002 Business Pattern Data for the area (Glasmeier, et al., 2007). The methodology used for the study also made a point to note that firms that could produce components for multiple areas were put into a parenthesis and noted. This is important as this may be an issue when conducting this study and will be documented the same way in order to reduce the chance of overstating the number of potential firms that may be identified. Researchers also included the socio-economic and population data for each sector and region on a county-by-county basis (Glasmeier, et al., 2007).

For the total Appalachian area, which encompasses thirteen states, the study found that 200,000 employees as well as 3,000 existing firms in manufacturing parts and components were affected by their methodology (Glasmeier, et al., 2007). However, while that is a fairly large number, the portion that Kentucky represented from this data was significantly smaller than other

states. Kentucky's portion was 4% of the total number of employees as well as 2% of total firms (Glasmeier, et al., 2007). Pennsylvania was represented higher in both categories at over 30% on both categories (Glasmeier, et al., 2007). One purpose of this study was to examine if partnerships could possibly be established in the reason, but this was not able to reach a firm conclusion due to differences in location and number of potential firms that were spread out through the region.

An important note from this study was that while firms were identified using primarily the NAICS codes, it was noted that it would be up to each firm individually on whether they entered the market or not as it is not obvious to outsiders of firms to know the exact capabilities of each firm (Glasmeier, et al., 2007), something that Debbage (2008) did not entirely address in his study. It is also important to note that two Kentucky counties that were identified as Appalachian in this study (Clark & Madison) are considered part of the Bluegrass Region for this proposed study

2.4 Summary

The literature reviewed was instrumental in the development of this study for several reasons. First off, varying sources from federal, state, to independent researchers have all agreed that on both a national and state level in the need for improving reliance on renewable energy sources while decreasing fossil fuel consumption. However, the means of getting there can vary greatly. Kentucky is the interesting case due to how heavily the state currently relies on coal production yet has drawn up a plan to increase the presence of renewable energy sources. At the present time, research linking existing manufacturing capabilities with renewable energy components has been severely lacking.

Debbage (2008) and Sterzinger (2008) have been the leading scholarly researchers on this topic though they have methods that are both similar and different. Because the research in Kentucky has been limited when compared to other states such as Indiana, this proposed study could not only increase the scope of knowledge into this field, but also help identify firms within the region.

CHAPTER 3 METHODOLOGY

3.1 Introduction

The study was conducted to identify firms in the Bluegrass Region of Central Kentucky that may have the capabilities of producing renewable components, per REPP standards. After identification, firms were then surveyed to gauge current involvement in renewable component manufacturing, potential future involvement, and potential barriers to entry. Although the methodology used by Debbage (2008) that relied on REPP was used as the primary framework, this study was customized to develop a more accurate analysis of the Bluegrass Region. One example was the use of the *2018 Kentucky Directory of Manufacturers* (Think, 2018) which is specific to the Bluegrass Region to identify firms. Debbage (2008) relied heavily on The ReferenceUSA (2008) database to gather firm information.

REPP assists with classifying renewable energy technologies into their individual component parts and also enables cataloging where existing conventional industries are located that could become suppliers of the new energy economy (Debbage, 2008; Sterzinger, 2008). REPP is based on the North American Industrial Classification System (NAICS) (NAICS, 2019). Every firm within North America reports at least one NAICS code which indicates the type of product or service that the firm provides (NAICS, 2019). As Debbage (2008) explained the NAICS codes have several levels of detail in particular regarding manufacturing.

> *For example, a first of 3 indicates Manufacturing, 334 is Computer and Electronic Product Manufacturing, and 33414 is Semiconductor and Related Device Manufacturing. The 6-digit NAICS are the standard level reported by all companies in North America. Companies reporting the same NAICS code are involved in similar activities, for example every company that reports 3339111 manufactures some type of pump (p. 7)*

REPP (Sterzinger, 2008) used 6-digit NAICS codes to identify firms that provided activities and services which are similar to the manufacturing of renewable energy components found in wind, solar, biomass or geothermal production. Appendix A lists codes that are used to identify firms with NAICS codes that pertain to renewable energy components (Debbage, 2008; Sterzinger, 2008) which all begin with the 33xxxx prefix for manufacturing.

One area of interest regarding the NAICS 6-digit codes is the breadth of companies that may be included based on the NAICS codes, meaning a company listed may not strictly be a manufacturing company (Debbage, 2008; Sterzinger, 2008). For example, this study had a respondent that was labeled as being a potential entrant to the market, but upon further questioning the respondent noted their company was a residential window company installer.

Another area to note is that when using these codes some companies had NAICS codes that appeared in more than one of the four renewable energy categories that was analyzed (solar, wind, biomass and geothermal). Debbage (2008) documented this differently in his findings and excluded counting these firms into two separate categories because doing so would inflate the economic data. Glasmeier, et al., (2007), however, included both groups but made a note of this observation. For the purpose of this study, companies were encouraged to select any and all renewable component fields that they may currently have business in.

The use of the 2018 *Kentucky Directory of Manufacturers* report was a variance from the Debbage (2008) report because Debbage used ReferenceUSA (2008) exclusively to inventory firms. The reason for choosing this report over ReferenceUSA (2008) was because the report was being maintained and updated bi-annually by the Kentucky Cabinet for Economic Development (Think, 2018). Therefore, the assumption was that because it was locally maintained, the report was more likely to be accurate in reflecting changes in manufacturing

firms within the area. Like ReferenceUSA (2008), this report was created using information provided by firms, however the primary information collection for this report was by conducting annual surveys (Think, 2018).

The initial process of identifying possible firms for selection started with the creation of an electronic spreadsheet containing all companies within the counties examined which totaled 296. Companies were listed in in the spreadsheet with the headings of "Company Name," "County," "NAICS," and "Description," that gave a brief description for each NAICS code used. Possible companies were selected by identifying companies with NAICS codes that REPP had identified as critical to the renewable energy component market. This narrowed the search to 48 firms identified as possibly engaged in the renewable energy market for the Bluegrass Region; with eight firms possibly engaged in more than one market due to the NAICS code (see Appendix C). Initial contact information was obtained through the 2018 *Kentucky Directory of Manufacturers* (Think, 2018) report. Labels for "Contact," "Phone," and "Email" were added to the electronic spreadsheet and updated from the manufacturers report (Think, 2018). For firms that did not have contact information, visits to the company websites and phone numbers provided from Google were used to find the contact information as needed.

Initial contact to firms were made by phone to verify or obtain contact information found in the 2018 *Kentucky Directory of Manufacturers* (Think, 2018) report because sometimes the companies did not have email information or a contact name. Phone conversations with respondents related to participation in the survey and notified potential respondents that the survey was completely anonymous, no identification data would be collected, the expected completion time of the survey was 5 minutes, and that a summary of findings would be provided if requested upon completion of the report. Prior studies (Chang & Krosnick, 2009; MERIC,

2009) had shown that telephone surveys resulted in higher response rates and even though data was collected through an online survey, the telephone contact was viewed as important in gaining a higher response rate. For companies that stated they did not want to participate, the researcher thanked the representative for their time and made a note on the spreadsheet that the company did not want to participate. Companies that did express interest in participating in the survey provided an email for the survey to be sent through Purdue Qualtrics© survey software. If a company was not reached by telephone on the first try, the researcher tried again 3 days later. If multiple attempts at contact went unanswered, the company was listed as a "no response" and no further contact via phone was attempted.

Qualtrics© was chosen over other online survey websites for several reasons. First, Qualtrics© has been cited by academic and professional journals as a peer reviewed survey tool (Qualtrics, 2018). Because it may be accessed online, it was convenient for respondents as opposed to telephone method because a respondent could answer at their own choice of time and pace. Online access also provided the advantage over traditional mail surveys because they have an added cost factor. Finally, Qualtrics© allowed the researcher to gather the survey responses and easily conduct statistical analysis on respondents' answers using cross-tabulations and graphs. Qualtrics© also allowed the survey to be exported into SPSS© format, a statistical software used for data analysis that was used for this research in examining the research question of correlation by using Chi-Square and Fischer's Exact Test.

3.2 Research Question

To this researcher's knowledge, no studies have been conducted where a survey was used as a complementary tool to identify potential renewable energy component manufacturers after identification using REPP standards (Sterzinger, 2008). By surveying companies, researchers

may have a better understanding of a firms' capabilities for production for or entry into the renewable component market. The purpose of this study was to fill this gap of information due to a lack of research. To summarize, the primary research question for this study was:

Is there a correlation between firms identified as capable of producing energy renewable components (using REPP standards) with firms who self-identified as capable of producing renewable energy components?

Secondly, a set of follow up questions that this researcher asked were:

For firms identified: 1) Were they aware they were on the REPP list for component parts? 2) What were the current and future needs that the companies believe are needed to grow in the renewable energy field? 3) What were the similarities and differences of firms from varying energy sectors in relation to survey responses?

3.3 Method Rationale

While Debbage's (2008) study on North Carolina remains one of the most in-depth studies this researcher has found in relation to REPP standards and the identification of potential renewable component firms, the methodology established by Debbage (2008) and others (Glasmeier et. al., 2007; Sterzinger, 2006; Tracz & Bailey, 2010) does have room for improvement. In addition to identifying firms through REPP, which has been established as the base standard, adding the survey component not only expanded upon previous research methodologies, but provided new insight as well. Furthermore, a study of this caliber has not been conducted in Kentucky, and could be beneficial to a multitude of stakeholders.

3.4 Participants

Initially 296 manufacturing companies were identified as being located within the Bluegrass Region. However, after applying REPP codes to the companies identified, it was established that only 48 of the 296 companies met the criteria as possibly being engaged in the renewable energy component manufacturing market. From those 48 companies, only 25 companies chose to complete the survey. This was a 52% response rate for the survey.

3.5 Instrumentation

Data collected for this study began with the inventorying of firms from the *2018 Kentucky Directory of Manufacturers* report (Think, 2018). Data collection happened during Summer 2018 from July 9th, 2018 to August 9th, 2018. Firms that met the established criteria were documented into an electronic spreadsheet under the following columns: Company Name, County, Contact, Phone, Email, Notes, NAICS code, Description. Companies identified were categorized into the field of renewable energy which they may provide service for based on REPP standards. For companies that met more than one category, documentation was created for all categories they may represent. Survey distribution was presented through online software. Data collected from the survey was then further analyzed using SPSS statistical software.

3.6 Procedures

This study was a quantitative analysis to examine the potential relationship between identification of firms as renewable energy component producers using REPP standards and self-identification as existing or potential producers of renewable energy component using surveys. The study built upon established methodology by replicating Debbage (2008) and applying it to the Bluegrass Region of Kentucky. This procedure was used because the research methods

established by Debbage (2008) were the most thorough. The REPP standards may be applied to other states and the established guidelines may assist other researchers to identify opportunities for increasing the renewable energy supply chain in their own areas.

One of the main differences between this study and that of Debbage (2008) is that the area covered was reduced from a total state to a smaller region within a state. Debbage (2008) applied his methodology to all of North Carolina, while this study only examined the before mentioned Bluegrass Region which consists of 6 counties in Central Kentucky. One reason for this is due to the researcher's knowledge of the Clark County area. This allowed the researcher better opportunities to verify data collected from Think Kentucky (2018). Another reason why this area was chosen was due to time constraints. A statewide study would have resulted in too large of a sample for the researcher to complete the study within the time allotted.

The researcher initially selected Fayette County (Lexington, KY) due to the researcher's knowledge and familiarity with the area. Fayette is the second largest county in Kentucky in demographics. However, to gain a better sample analysis, the researcher expanded the study to include the area known as the Bluegrass Region based on the definition of the Lexington Chamber of Commerce (Regional, 2013). This area included Fayette and the immediate surrounding counties of Clark, Jessamine, Woodford, Madison, and Scott.

Firms in the region were inventoried based on their NAICS codes (Appendix A) into one of the four major categories of renewable energy production (solar, wind, biomass, geothermal) by using the 2018 *Kentucky Directory of Manufacturers* report (Think, 2018). Identified firms were then inventoried into an electronic spreadsheet with the following headings: Company Name, County, Contact, Phone, Email, Notes, NAICS code, Description. Debbage (2008)

included the additional heading of Region, however since this study only focused on the Bluegrass Region, this heading was omitted.

Initial contact to firms was made by phone to verify contact information and to gauge interest in participating in the survey. Representatives of companies that were contacted were told the survey was completely anonymous, that no identification data would be collected, the expected completion time of the survey was 5 minutes, and that a summary of findings would be provided if requested upon completion of the report. For companies who stated they did not want to participate, the researcher thanked the representative for their time and made a note on the electronic spreadsheet regarding the firm did not want to participate. Companies which expressed interest in participating in the survey were instructed to provide an email address for the survey to be sent to through Purdue Qualtrics© (See Appendix B). If a company was not reached by telephone on the first try, the researcher tried again 3 days later. After three unsuccessful attempts to make contact, the company was listed as a "No response" and no further contact was made via phone. If a firm did not have phone contact and an email contact was found, then the email was sent as a proper cover letter with the survey link to consider for completion (See Appendix B).

After distribution of the survey, firms were contacted again 5 business days after agreement for follow up on any non-response. After 3 attempts of collecting a response from firms, the firm was then documented as a non-respondent. Firms that did complete the survey were promptly sent an email thanking them for their response to verify that the researcher did receive the survey along with a notice that findings would be sent if requested.

The survey began with a short message which thanked participants for taking the time to complete the survey (see Appendix B). This was followed with a page that had terms and

definitions that were used in the completion of the survey that were established from the MERIC (2009) survey. Terms used were: energy production, green building, green manufacturing, green farming, green public administration, and green salvage/remediation. The survey was comprised of sixteen questions with nine being multiple choice questions, six were Likert (1932) scale questions, and one was an open-ended question at the end of the survey that asked participants to add any additional information they felt may be needed. All multiple-choice questions from the survey were taken from the previous peer reviewed survey study by MERIC (2009) because it was designed to gather needed demographic information, as well as information related to current engagement in the renewable energy market, future engagement in renewable energy market, and workforce needs. All Likert (1932) type scale questions were chosen from the IEDC (2013) survey as markers for potential barriers to entry that firms may encounter. The complete survey is in Appendix B.

Survey responses were stored into Purdue Qualtrics©. Qualtrics© is a survey software that allowed the researcher to identify which firms have responded to the survey. In cases where the respondents wanted extreme anonymity, an anonymous link was sent to them. Qualtrics© also completed some data analysis using graphs, basic statistics, and cross-tabulations. Qualtrics© was used to save survey data to be transferred into an SPSS© file. SPSS© is a data analysis software that is widely used through academia. It was also selected because of its ease of use and familiarity to the researcher. Information analyzed included possible relationships related to the following: demographics, noted barriers to entry, interest in producing components, current renewable markets currently served, number of firms responding by county, and county-by-county comparison.

3.7 Data Analysis Plan

Data collection and analysis for this plan lasted several weeks. The timeline for the study is shown in Table 3.1.

Table 3.1 Data Analysis Plan

Week	Area of Analysis	Result for Week
1	Inventory of Firms	Collection of firms that met REPP Standards
2	Contact Information	Collection of contact information for firms
3	Survey	Contact firms, distribute surveys
4	Survey	Contact firms, follow up with non-respondents, distribute surveys
5	Survey	Contact firms, follow up with non-respondents, distribute surveys
6	Discussion	Analyze results and findings

The first week of the study was used inventorying firms that met REPP standards. The second week was spent garnering contact information for the firms identified. Weeks three through five were used to establish contact with firms and the distribution of surveys. Week six was used to analyze results and findings of survey responses against initial expectations and research questions.

3.8 Verification

This study used data from the 2018 *Kentucky Directory of Manufacturers* (Think, 2018) report conducted by an agency in Kentucky which uses NAICS classification and is updated bi-annually. This is locally maintained by the Kentucky Department of Economic Development and should be relatively accurate in establishing a baseline for the number and types of firms in the area. Respondents also were asked to provide demographic information to assure accurate reporting of data.

3.9 Conclusion

Due to emphasis in federal and state guidelines in examining methods to increase usage of renewable energy sources, this study may be considered one of potential importance. Though the Bluegrass Region is just one region in the state of Kentucky, exploring a potential renewable energy supply chain from component manufacturing could have positive ramifications on other regions in the state, specifically the urbanized areas of Louisville and the Greater Cincinnati area of Northern Kentucky. Furthermore, because limited research has been found to validate identification with surveying companies, this study may provide a new research method for other researchers in attempting to identify renewable component manufacturing.

CHAPTER 4 RESULTS

4.1 Introduction

The initial number of companies listed within the Bluegrass Region was 296 manufacturing companies. After application of REPP methods to identify potential renewable energy component suppliers the number was reduced to only 48 companies. Of the 48 companies, 25 companies participated in the survey for a 52% response rate. Respondents were asked to engage in topics related to: company demographics, providing goods or services in the "green sector," future plans to engage the market, current engagement in the renewable energy market, and skills needed to grow in the renewable energy field. Furthermore, participants were asked to record answers on a Likert (1932) scale from "0" (Not Challenging) to "10" (Extremely Challenging), and "5" being considered Neutral on issues related to potential barriers to entry that included: investment, government policies, underdeveloped supply chains, and workforce availability related to growth in the renewable energy field.

Respondents were also asked to disclose their current job titles. The majority of respondents (10) related their job title to engineering. Six identified themselves as managers, while two identified themselves as being owners. Other titles provided by respondents included: President, Maintenance Specialist, Compliance Support, Technology Development, Product Leader, Designer, and Manufacturing Sales Support.

4.2 Questions Used

Table 4.1 Questions Used for Survey

Question	**Research Question Answered**	**Type of Question**
1. What is your current job title?	Demographic	Multiple Choice
2. Which county is your industry in?	Demographic	Multiple Choice
3. How many employees work at this business?	Demographic	Multiple Choice
4. Does your business currently provide goods or services in any of the following "green sectors"?	Current engagement	Multiple Choice
5.Does your company have any plans in the next 1-3 years to do so?	Future engagement	Multiple Choice
If yes, which sector?	Future engagement	Multiple Choice
6. Does your business currently produce component parts for any of the following renewable energy markets?	**Primary research question**	Multiple Choice
7. Before this survey, was your company aware of being identified as a possible renewable energy component supplier?	**Primary research question**	Multiple Choice
8. Are any of the following methods used at your business to prepare current workers to produce green products or services?	Potential barriers	Multiple Choice
9. What new skills or knowledge will future employees need in order to perform work activities at your business?	Potential barriers	Multiple Choice
10. How challenging are the following issues in your view for growth of the renewable energy field?	Potential barriers	Likert Scale
Lack of investment capital or financing (funding)	Potential barriers	Likert Scale
State government policy and regulations	Potential barriers	Likert Scale
Federal government policy and regulations	Potential barriers	Likert Scale
Underdeveloped renewable energy supply chains (logistics & transportation included)	Potential barriers	Likert Scale
Mismatch of instate research and development capacity	Potential barriers	Likert Scale
Workforce availability	Potential barriers	Likert Scale
11. Is there any other information you would like to provide?	Potential barriers	Open Ended

Table 4.1 contains the eleven questions used for the survey. The table is divided into three columns. The first column displays the questions used for the survey. The second section titled "Research Question Answered," identifies each question within several categories. The first three questions were relevant to demographic information. Questions 4 and 5 were used to

document current and possible future engagement in "green sector" jobs. Questions 6 and 7 focused on the primary research question for this study regarding the relationship between outside identification with company self-identification within the renewable energy component market. The remaining questions were labeled as "potential barriers," and assisted in the research within the areas of training, policy, research, and workforce availability.

The third section of Table 4.1 provides labels for each survey item by question type. The first nine questions were multiple choice questions. Question 10, and all subsections, used a Likert Scale (1932). Question 11 was an open-ended question allowing respondents to provide more information as needed.

4.3 Company Demographics

Table 4.2 shows the breakdown of respondents by county. It also shows the following: population for each county, the number of respondents, number of non-respondents, total identifiable companies, and total manufacturing companies per county. Table 4.2 also contains the percentages of respondents for the total identifiable companies and total manufacturing companies per county. The majority of respondents (11) were from Fayette County (Lexington); the largest market of all counties observed. Madison County was the next largest county for with 5 respondents. Furthermore, Scott and Clark Counties had 3 respondents each, while Jessamine County garnered 2 respondents and Woodford County only had 1 respondent. No respondents or potential companies were analyzed in Bourbon County. Regarding response rate, Clark and Scott Counties had the highest response rates from companies identified with a 60% rate. Woodford, Madison, and Fayette Counties all recorded at least a 50% response rate. Jessamine County was the only county with a respondent that totaled under a 50% response rate. Overall, 16% of all

companies in the area were identified as potentially being a renewable energy component supplier.

Table 4.2 Survey Response by County

County	Population	# of Respondents	# of Non-Respondents	Total Companies	% of Respondents	Total manufacturing Companies	% of Companies Identified as Possible Suppliers
Bourbon	20,029	0	0	0	0%	14	0
Clark	36,046	3	2	5	60%	35	14%
Fayette	321,959	11	10	21	52%	121	17%
Jessamine	53,375	2	3	5	40%	36	14%
Madison	91,226	5	5	10	50%	47	21%
Scott	54,873	3	2	5	60%	29	17%
Woodford	26,368	1	1	2	50%	14	14%
Total	**603,876**	**25**	**23**	**48**	**52%**	**296**	**16%**

Respondents were then asked, “How many employees work at this business?” Responses were in the size classes: “0,” “1-100,” “101-500,” “501-1000,” “More than 1000,” and “Don’t know/not sure.” Figure 4.1 displays the breakdown of company size demographics. Most respondents stated company size was between 1 to 500 employees (15) while several (8) respondents stated their company was “More than 1000.” One respondent registered a company size of “501-1000” and one respondent stated they did not know their company size.

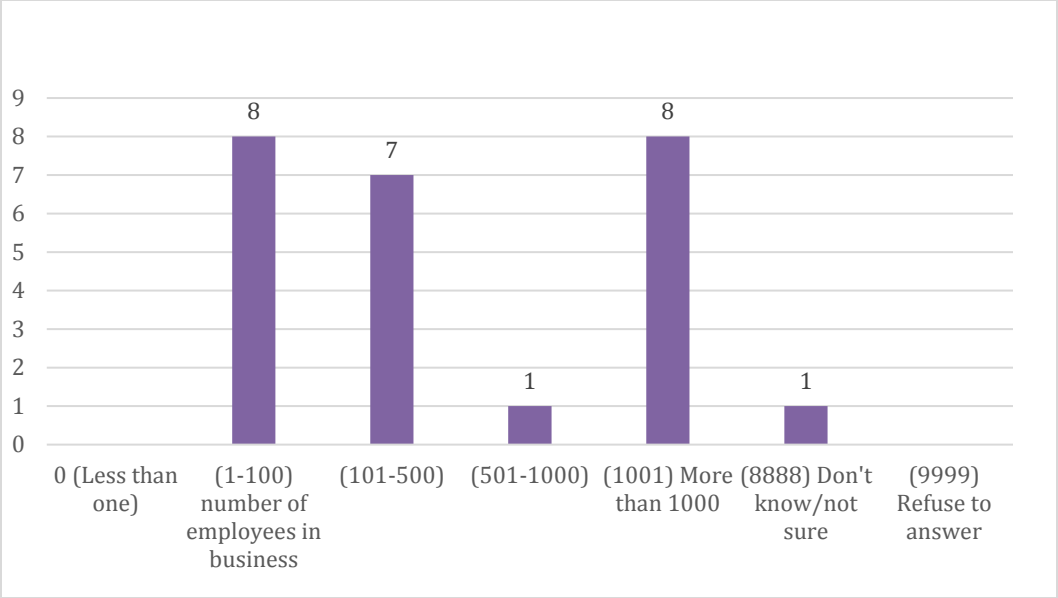

Figure 4.1 Survey responses by company size

4.4 Response to "Green Sector"

After initial demographic information was collected, the next series of questions dealt specifically with whether companies were currently engaged in the "green sector" by providing goods or services through several different fields. These fields were as followed: energy production, green building, green manufacturing, green farming, green public administration, green salvage/remediation, none of the above, or no. Respondents were encouraged to check all answers that adequately applied to their respected companies.

Figure 4.2 displays the breakdown of the responses. The majority stated that their company was either in "Energy Production" (8 responses), or "Green Building" (10 responses). Surprisingly, since this study was aimed primarily at manufacturing companies, only 6 responses responded with "Green Manufacturing" as an area of current engagement. Four respondents stated that they do not currently engage in the market at all. This is interesting to note as one of the main focuses of this study was to examine if identification through REPP was correlated to

engagement into the renewable energy field. Though this was not a direct answer to that question, it did reveal that a generalized assumption cannot be made regarding in renewable energy production; four respondents for this study is roughly 20% of all respondents. Finally, no respondents reported being engaged in "Green Farming."

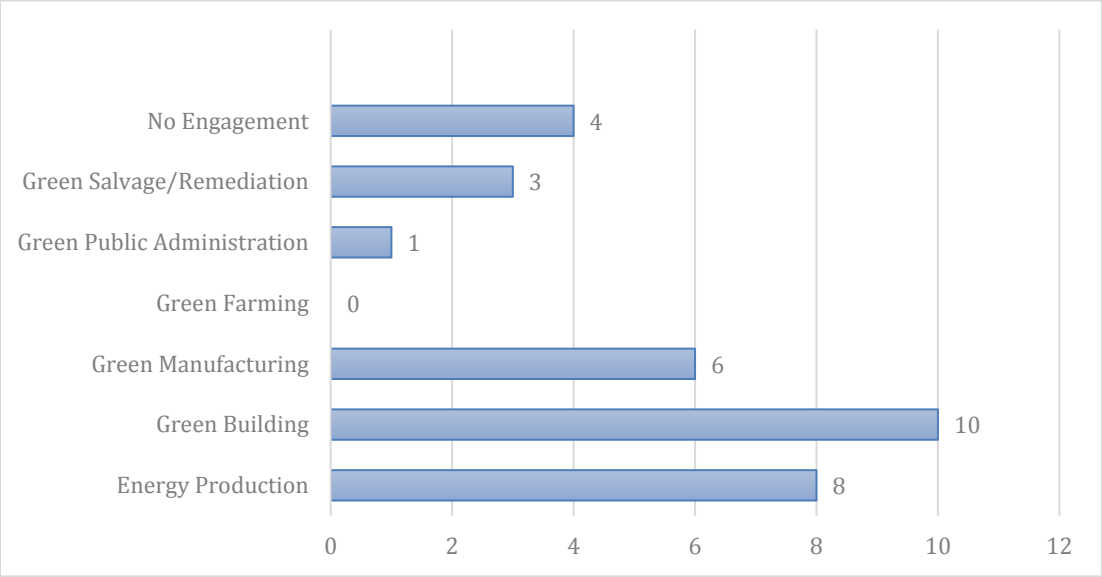

Figure 4.2 Current engagement in the "green sector"

In the next question respondents were directed to state whether their company had plans in the next 1-3 years to engage in the renewable energy market. A total of sixteen respondents stated that "yes," they had plans to do so while again four respondents stated "no" they did not. Finally, five respondents were unsure or did not know if their company had plans to do so.

For those 16 that responded "yes," they were asked which sector this would encompass. Respondents were able to select more than one possible response. The majority of respondents stated that "energy production" (9 responses), "green building" (8 responses), and "green manufacturing" (7 responses) were the main areas of focus. Again, no respondents believed their company would engage in the "green farming" field.

4.5 Production of Renewable Components and Correlation

Respondents were then asked if their business currently produced component parts for any of the renewable energy markets of solar, wind, biomass, or hydroelectric. Respondents were given the options of "Other," "Not sure/don't know," and "No." Furthermore, the immediate question asked respondents whether before the survey if their company was aware of being identified as being a possible renewable energy component supplier. These two questions (Questions 6 & 7) served as the basis for observing whether a correlation existed between outside identification using REPP against self-identification.

For the initial question in relation to production of renewable components, of the 25 respondents solar and hydroelectric garnered four responses apiece, while wind had three responses, and biomass only had two responses. This resulted in a total of six firms that identified as currently producing components in the renewable energy field. One firm identified as being in all four renewable fields, another was in three fields, and two firms stated they were in two of the fields. Three respondents were not sure if their company was in the market. Three respondents stated "other" and listed as followed: "provider of parts to automotive market that produces "green" vehicles," "our company manufactures energy efficient residential windows," and "design, build, and test demand response equipment to help reduce building energy consumption." All other respondents (13) stated that they were not producing in the renewable energy component market.

Responses were almost evenly split between the three options of "Yes," "No," and "Not sure/don't know" when respondents were asked if their company was aware of being identified as a possible renewable energy component supplier. Nine respondents answered their company was aware, while the two other options garnered eight responses each.

To establish a correlation the data was analyzed in SPSS© while using a cross tabulation for a Fisher's Exact Test. Fisher's Exact Test is used when the number of observations obtained for analysis is small and the need to consider all possible cell combinations that would result in marginal frequencies is warranted (Bower, 2003). A new variable row was created in SPSS© that grouped all respondents who stated they currently produced renewable energy components into one group. The other group consisted of those who stated they did not or were unsure if their company was currently in production of renewable energy components. This variable was run as a cross tabulation against the variable of whether the company was aware before the survey of being a possible renewable energy component supplier.

Figure 6 shows the cross-tabulation of responses from the two questions of whether a company was currently engaged in the renewable component market with the question of before this survey was the company aware of being identified as a possible renewable energy component supplier. Five of the respondents who answered "does not or unsure of production" category was aware before completing the survey that their company may have been a possible renewable energy supplier. Seven responses of the "does not or unsure of production" were not aware of their company being identified as a supplier before the survey while another seven respondents of the "does not or unsure of production" were also not sure whether their company was aware of being identified as a possible renewable energy component supplier.

Four of the respondents who recorded responses as their company currently producing components were aware before the survey of their company's capability. Other results included one respondent who recorded their company as currently producing renewable components that was unaware before the survey that their company was a possible component supplier, and one

respondent whose company produced renewable components that was not sure before the survey of their company being identified as a possible supplier.

Cross tabulation for Question 6 (Does your business currently produce component parts for any of the following renewable energy markets?) and Question 7 (Before this survey, was your company aware of being identified as a possible renewable energy component supplier?)

6. Does your business currently produce component parts for any of the following renewable energy markets?	7. Before this survey, was your company aware of being identified as a possible renewable energy component supplier?			
	Yes	**No**	**Not Sure/Don't Know**	**Total**
Does not produce or unsure of production	5	7	7	**19**
Produces component	4	1	1	**6**
Total	**9**	**8**	**8**	**25**

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig (2-sided)	Exact Sig (1-sided)	Point Probability
Fisher's Exact Test	2.769	-	-	0.287	-	-
N of Valid Cases	25					

Figure 6 Cross-tabulation and analysis of groups

To answer the primary research question regarding correlation between self-identification of production of component parts against identification through REPP standards, the Fisher's Exact Test was calculated and the result was 0.287, or insignificant between the two variables at a critical alpha level of 0.05. This research study failed to reject the null hypothesis. The implications from this result is that the identification of a potential firm through REPP standards does not equate to the company having the capabilities or the intent to enter the renewable energy component market.

4.6 Current and future job skills

The next topic in the survey related to current and future job skills that companies currently exhibit to prepare current workers to produce green products or services. The follow-up to this was to ask, "What new skills or knowledge will future employees need in order to perform work activities at your business?" Respondents for both questions were asked to check all answers they believed applied to their company.

For the initial question on current methods, Table 4.3 breaks down the varying answers and how those corresponded with the varying industry responses in the renewable energy component field. Those respondents who listed their answers for production as "other" or "not sure/don't know," were also included. No respondents who had previously indicated "none" in relation to production of component parts responded to this section.

From the responses, it appeared the most widespread response was "in house/classroom/on-the-job training;" essentially meaning the majority of companies surveyed believe the best method was to start from within their own companies. The second highest response was from industry recognized training and apprenticeship programs. Surprisingly, only a handful of companies cited formal education in the college setting as a current method being used for preparation.

Table 4.3 Survey Response for Current Methods for Training

Industry Response	In house classroom/on-the-job training	Industry recognized green certification or training	Apprenticeship programs	Hire only workers who are already trained	Community College courses	College Degree (AA/AS or above)	Others	Don't Know/Not Sure
solar	3	0	0	0	0	0	1	1
wind	2	0	0	0	0	0	1	1
biomass	1	0	0	0	0	0	1	1
hydroelectric	3	0	1	0	1	0	2	1
other	3	3	1	0	1	1	0	0
not sure/don't know	3	0	1	1	0	0	0	0
TOTAL	**15**	**3**	**3**	**1**	**2**	**1**	**5**	**4**

For the question regarding future new skills or knowledge, the majority of responses centered around three particular areas. These areas were "principles of energy conservation," "waste minimization," and "pollution reduction and control," as shown in Figure 4.4. Other areas of concern for new skills centered around "information technology" and "vehicle technology/maintenance." Surprisingly, only eight respondents noted that future workers would need skills centered around "alternative energy," even though one of the main areas of interest is areas of energy conservation. Six respondents stated they "Don't know/unsure" of what future skills would be needed for their company. One respondent answered "Others" and when asked to elaborate stated "understanding economic impacts of renewable energy through understanding of our nation's energy infrastructure how renewable energy resources are financially rewarded as the electrical grid ages and deteriorates."

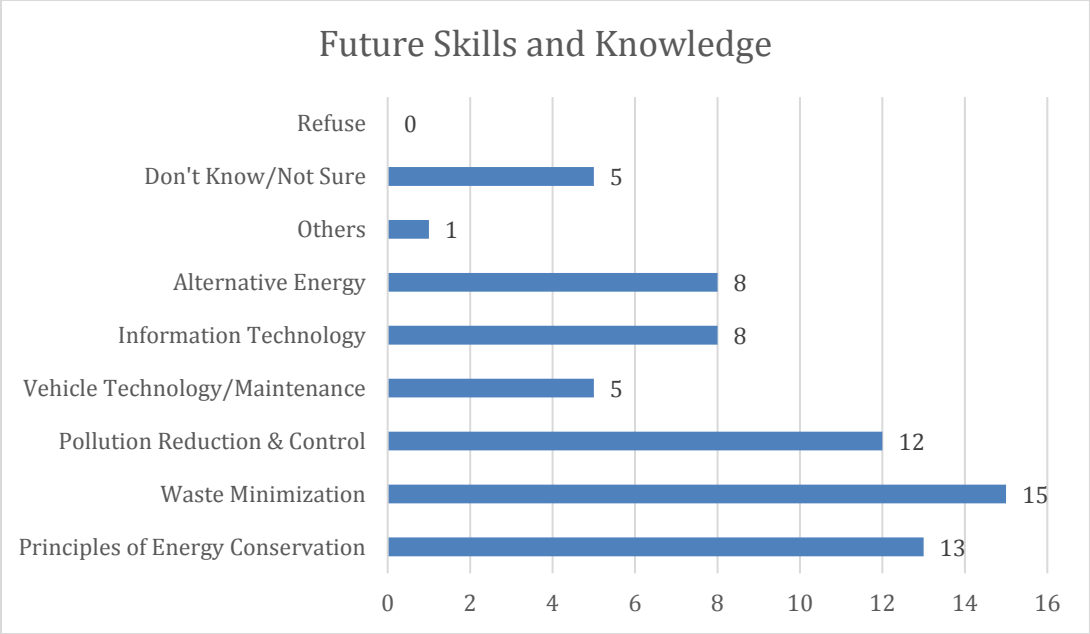

Figure 4.3 Survey responses for future skills and knowledge

4.7 Lack of investment capital or funding

The next several questions asked respondents to answer on a Likert (1932) scale from "0" (not challenging) to "10" (extremely challenging) questions related to how challenging several issues were in their view related to growth in the renewable energy field. The first question was related to the "lack of investment capital or financing (funding)." This question was to determine if money was an issue from the companies' perspectives. Data from this response was broken down into two figures of basic statistics that showed the following values: minimum, maximum, mean, standard deviation, and variance. Table 4.4 contains the breakdown of responses based on industry. Table 4.5 contains the difference in response rates from a county-by-county basis.

Examining the breakdown of responses from a renewable component production standpoint showed slight differences in beliefs of the impact of capital. For instance, those in the solar and wind industry stated they believed this was slightly challenging. Biomass,

hydroelectric, and those who responded as "other" hovered around a neutral response from their perspective. Those who weren't sure of their production of renewable components also stated in a belief of a slight challenge of investment capital. Responses are not included for respondents who explicitly stated that their company did not produce component parts for a renewable energy field.

Table 4.4 Investment Capital Breakdown by Renewable Component

Field	Solar	Wind	Biomass	Hydroelectric	Other	Not Sure/Don't Know
Mean	6.5	6.33	4.5	5	5.67	6
Std Deviation	0.87	0.94	2.5	2.45	3.3	2.16
Variance	0.75	0.89	6.25	6	10.89	4.67
Count	4	3	2	4	3	3

When broken down on a county basis, differences between respondents were noted to be noticeably different in scale. Four of the six counties had average responses that were above neutral for their view of the challenges related to capital. Those in Clark were the lowest while respondents in Madison held the highest beliefs in the challenges regarding investment and capital. The largest county with the most respondents, Fayette, averaged a relatively "neutral" response.

Table 4.5 Investment Breakdown by County

County	Clark	Fayette	Jessamine	Madison	Scott	Woodford
Mean	3.33	5.64	6.5	7.2	6.33	7
Std. Deviation	1.7	2.35	1.5	1.94	2.49	0
Variance	2.89	5.55	2.25	3.76	6.22	0
Count	3	11	2	5	3	1

4.8 State and federal policy and regulations

Regarding the view of state policies and regulations from companies that produce renewable energy components or were not sure, the consensus seemed to veer toward not

challenging to neutral overall. The interesting outlier from this was from the segment of respondents that stated "other" as their response whom on average rated state policy above a 7, which can be described as somewhat challenging on the scale. Table 4.6 does not include the responses of respondents that stated their company did not produce renewable energy component parts.

Table 4.6 State Policy Breakdown by Renewable Energy Component

Field	Solar	Wind	Biomass	Hydroelectric	Other	Not Sure/Don't Know
Mean	4	5.33	5.5	5	7.67	6
Std Deviation	3.39	2.87	0.5	2.45	3.3	2.16
Variance	11.5	8.22	6.25	6	10.89	4.67
Count	4	3	2	4	3	3

As shown in Table 4.7, responses shifted and showed more variation on the county breakdown of this issue. Three counties identified this as being a somewhat challenging issue. This included Fayette county, again the largest county, whom averaged slightly above a "6" response. This may be of important note as more respondents are from this area. Woodford county had the highest response at 9.00, but it should be important to note that only one respondent was from this specific county.

Table 4.7 State Policy Breakdown by County

County	Clark	Fayette	Jessamine	Madison	Scott	Woodford
Mean	7	6.55	5.5	4.2	4.33	9
Std. Deviation	1.63	2.31	0.5	3.12	2.49	0
Variance	2.67	5.34	0.25	9.76	6.22	0
Count	3	11	2	5	3	1

Similar trends were also shown when examining the issues of federal policy as a challenge from respondents in Table 4.8. Based on renewable component production, all

respondents stated this was slightly below neutral to neutral overall. Those who had stated "other" as their response garnered the highest average of rating government and overall viewed federal policy as a somewhat challenging area for growth in the renewable energy field.

Table 4.8 Federal Policy Breakdown by Renewable Energy Component

Field	Solar	Wind	Biomass	Hydroelectric	Other	Not Sure/Don't Know
Mean	3.75	5	5.5	4	7.33	5.67
Std Deviation	3.03	2.45	0.5	3.39	1.89	3.3
Variance	9.19	6	0.25	11.5	3.56	10.89
Count	4	3	2	4	3	3

Federal policy by county breakdown had four of the six counties rating the federal government policies at least slightly above "neutral" for impacting the growth of the renewable energy market as shown in Table 4.9. The two highest counties were Clark (7.0) and Woodford (8.0). Madison, Fayette, and Scott counties viewed the area overall as either right under "neutral" or slightly above.

Table 4.9 Federal Policy Breakdown by County

County	Clark	Fayette	Jessamine	Madison	Scott	Woodford
Mean	7	5.45	6.5	4.8	4.33	8
Std. Deviation	1.63	2.19	1.5	3.25	2.49	0
Variance	2.67	4.79	2.25	10.56	6.22	0
Count	3	11	2	5	3	1

4.9 Underdeveloped renewable energy supply chains

Respondents were asked to rate the challenge related to the renewable energy supply chain being underdeveloped. Responses were examined by responses from renewable energy component producers in Table 4.10, and from a county basis in Table 4.11.

Based on renewable energy component producers, those who were in wind and solar category tended to believe this issue was neutral to not challenging. However, those in biomass,

hydroelectric, and even those who had classified responses as "other" all believed the renewable energy supply chain is a challenging issue. Those who were unsure of production of renewables also tended to view the renewable energy supply chain as "neutral." Responses from respondents who stated their company did not produce renewable energy component parts was not included.

Table 4.10 Underdeveloped Renewable Supply Chain by Component

Field	Solar	Wind	Biomass	Hydroelectric	Other	Not Sure/Don't Know
Mean	5.75	4.67	7	6.25	6.67	5
Std Deviation	2.59	2.05	0	2.59	0.47	0.82
Variance	6.69	4.22	0	6.69	0.22	0.67
Count	4	3	2	4	3	3

All six counties averaged at least a "neutral" response to the issue of supply chain development. Four of the six county averages could be considered as believing the issue was in the "challenging" category.

Table 4.11 Underdeveloped Renewable Supply Chain by County

County	Clark	Fayette	Jessamine	Madison	Scott	Woodford
Mean	6	5.91	7	6.6	6.33	5
Std. Deviation	0.82	1.88	2	2.42	1.25	0
Variance	0.67	3.54	4	5.84	1.56	0
Count	3	11	2	5	3	1

4.10 Mismatch of instate research and development capacity

In relation to government policy, respondents were asked to rate the challenge of in-state research and development capacity. Again, responses were examined in the category related to production of renewable energy components and of a breakdown of county basis. Table 4.12 displays the data as it pertains to renewable component responses while Table 4.13 delves in to the county comparison.

In Table 4.12, it can be observed that only one renewable component market responded that research and development capacity was a challenging issue, the biomass sector. All other markets did not see this as a challenging issue, even providing responses below "neutral." Again, those who were in the "Other" category had a higher response rate of believing this to be a slightly challenging issue with their responses averaging higher than all other responses at 6.33. It is interesting to note that the maximum single response from the four renewable energy sectors was a 7.

Table 4.12 Mismatch of In-State Research and Development Capacity by Component

Field	Solar	Wind	Biomass	Hydroelectric	Other	Not Sure/Don't Know
Mean	4.5	4	6	4.25	6.33	4.33
Std Deviation	2.06	2.16	1	2.28	1.89	1.25
Variance	4.25	4.67	1	5.19	3.56	1.56
Count	4	3	2	4	3	3

Results for the county-by-county basis showed slight variation in Table 4.13. Five of the six county responses labeled the issue as "neutral." Two counties, Scott and Woodford, recorded low averages of around 3 concluding this issue was closer to not challenging at all. The only county that answered research as being a slightly challenging issue was Jessamine with a 6.0.

Table 4.13 Mismatch of In-state Research and Development Capacity by County

County	Clark	Fayette	Jessamine	Madison	Scott	Woodford
Mean	4.67	5.27	6	5.2	3.33	3
Std. Deviation	2.49	2.34	1	1.17	1.7	0
Variance	6.22	5.47	1	1.36	2.89	0
Count	3	11	2	5	3	1

4.11 Workforce Availability

An issue of concern that was reported when respondents were asked for additional information they wanted to share relevant to the study was primarily focused on workforce

availability and finding quality employees. Fourteen respondents in total gave feedback that their biggest issue and concern was for finding their next employee.

Table 4.14 contains the responses on this issue by renewable energy component. Overall response groups rated this as a challenging issue. The highest was found in the hydroelectric sector as the average response rate was 8.00. The lowest single response found in renewable sectors was in the biomass feedback at 6.0, which is still seen as slightly challenging. Those who were "Not sure/don't know" had the lowest response average of slightly above neutral. Those who stated their company did not produce renewable components was not included in this Table.

Table 4.14 Workforce Availability by Component

Field	Solar	Wind	Biomass	Hydroelectric	Other	Not Sure/Don't Know
Mean	7.75	7.33	6.5	8	6.33	5.67
Std Deviation	0.83	0.47	0.5	0.71	2.87	2.62
Variance	0.69	0.22	0.25	0.5	8.22	6.89
Count	4	3	2	4	3	3

When comparing workforce availability concerns from the county perspective the majority of county responses labeled the issue as a challenge as shown in Table 4.15. Both Woodford and Clark County respondents viewed workforce availability as "somewhat challenging." One county that did not show a concern for this was Scott, which had an average of 3.00. Response from this county were a 2.00 and a 4.00. All other counties reported at least above "neutral" for their average.

Table 4.15 Workforce Availability by County

County	Clark	Fayette	Jessamine	Madison	Scott	Woodford
Mean	7.67	6.91	6	5.6	3	7
Std. Deviation	1.25	2.23	1	3.26	1	0
Variance	1.56	4.99	1	10.64	1	0
Count	3	11	2	5	3	1

4.12 Potential economic development for growth

The next survey responses were to structured questions revolving around respondents identifying potential economic development support that would help their company grow in the renewable energy field. Respondents were asked to check all answers that they believed applied. Choices for this question were as followed: formalized strategic plan for growing renewable energy in the state, meeting with state/local policy makers, meeting with utility regulators about opportunities and challenges for renewable growth, meeting with venture capitalists, and analysis of workforces' needs of renewable energy or efficiency businesses. Respondents could also refuse to answer or select "Don't know/not sure."

The bar graph in Figure 4.5 illustrates how respondents viewed the potential economic support needed. The option selected the most was the meeting of state or local policy makers with eleven respondents. Related to this response was nine respondents who believed that the state needed a formalized strategic plan for growing the renewable energy field within the state. Meeting with utility regulators also scored relatively high as ten respondents believed this to be in their best interests for support. Surprisingly, analysis of workforce needs of renewable energy or efficiency business scored the lowest as only 4 respondents believed this would help. This is intriguing as previous questions showed an overall shared belief that workforce would be a challenge for the future, but for this question not many respondents believed an analysis would be something of importance. Seven respondents stated they were unsure of what would help their company.

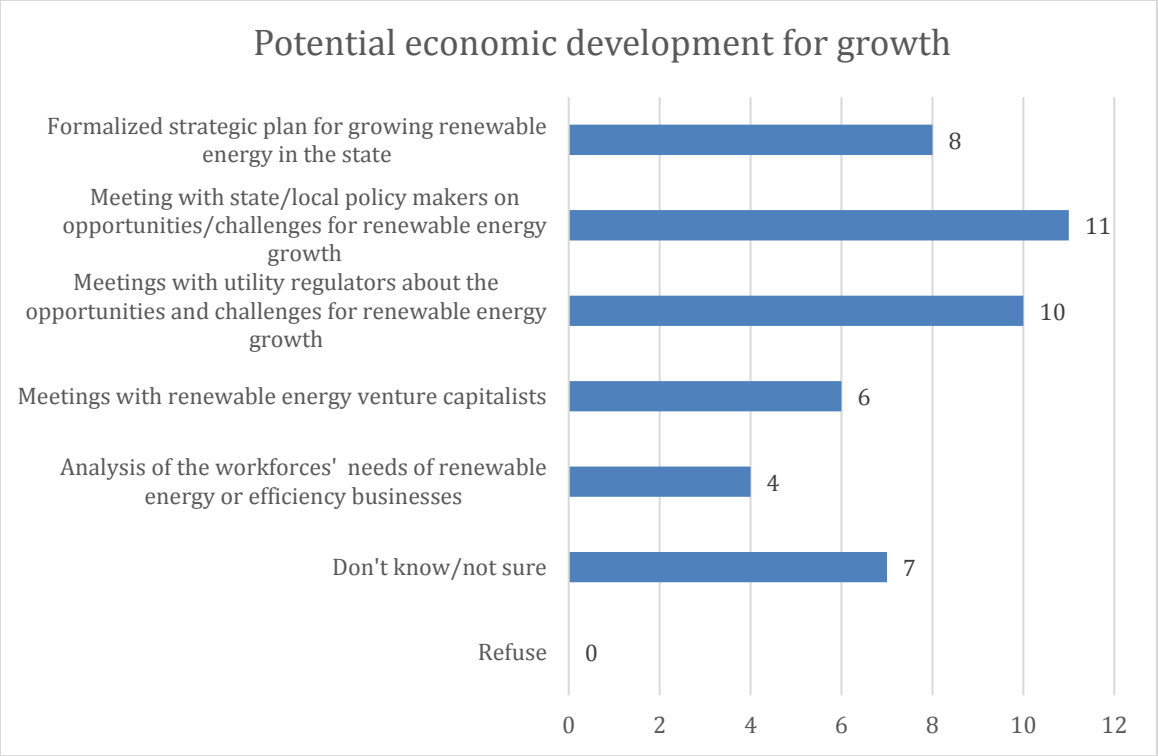

Figure 4.4 Survey responses for potential economic development for growth

4.13 Conclusions

One area of focus of this study was to determine whether the companies identified were actively engaged in the renewable component market. This study also allowed the researcher to gain demographic information and collect data regarding varying topics that included current engagement in the "green sector" industry, future areas of concern for development, and open-ended responses for respondents to share feedback on what they believed to be issues of concern through an anonymous outlet.

The most important data gained from the results of this survey was being able to examine whether a correlation existed between being identified as a producer through REPP standards against the self-reporting of companies identified. From the data analyzed in this survey, it does not appear a conclusion can be reached indicating that identification through REPP means a

company is actively engaged within the renewable energy component industry. Furthermore, it was noted that when given choices of possible challenging issues in the field, the most pressing concern from respondents was in relation to workforce needs and finding the right employees. Another point of interest is that in developing skills, most companies that responded favor on-the-job training and in-house training to better prepare their workforce as opposed to formalized education.

CHAPTER 5 DISCUSSION

5.1 Introduction

The purpose of this study was to build upon methodology used by Debagge (2008) whom used identification of REPP (Sterzinger, 2008) standards through NAICS as a practice of predicting potential firms that may be engaged in the renewable energy component market. Others (Craig, et al., 2011; MERIC, 2009; Office, 2014) have also used similar methods for varying states as well. This was the first study to the researcher's knowledge that used this method in Kentucky and the Bluegrass region. Furthermore, this study assisted in determining whether identification of firms from REPP standards as an accurate predictor of actual engagement in the renewable component market by responses could be garnered from self-analysis of identified firms. Lastly, the researcher attempted to gain knowledge on possible similarities and differences between current companies within the renewable energy component market and the comparison of businesses on a county basis.

The survey response rate was high with 25 of 48 companies responding for a 52% response rate. Most companies contacted were rather intrigued at the survey and willing to participate. Only four companies immediately declined to participate in the survey. Many respondents to the survey stated that the ability to complete the survey on their own time through internet, as well as the anonymity of the survey was helpful in influencing them to complete the survey. Because this view was expressed several times throughout the survey, the method of online distribution was believed to be critical in the high response rate.

From the data analysis of the survey responses, the researcher was able to conclude several things. First, based on the data collected and from running a Fisher's test in SPSS© it was concluded that a correlation did not exist between being identified through REPP standards and

from the current engagement of the renewable energy component market that was identified from self-analysis. Second, when asked to gauge challenging issues facing the industry and future growth, workforce needs were the highest challenge raised not only between the different industries, but on a county basis as well. The data collected should help in bridging a gap not only between previous studies using REPP, but in creating new knowledge for Kentucky and the Bluegrass Region related to the potential renewable energy component market.

In relation to validity of the study it is important to note several things. First, the study used peer reviewed surveys from MERIC (2009) and IEDC (2013) for replication. The study also replicated research using REPP standards for identification of potential renewable energy component firms that both Debbage (2008) and Sterzinger (2008) used. The combination of survey methodology and process was important for the success completion of this study. Third, the respondents to this survey were representatives of the firms identified which gave first-hand knowledge to the business practices of the company based on respondent knowledge.

5.2 Correlation between identification and self-assessment

The primary focus for this study was to use REPP standards to identify companies and to determine if identification based on REPP standards reflected the accuracy of self-identification using surveys. When respondents were asked if their businesses currently produced component parts for any of the renewable energy markets of solar, wind, biomass, or hydroelectric, most respondents stated they were not in any of those markets. Only six respondents were linked to any involvement with renewable components. Solar and hydroelectric garnered four responses each, while wind had three responses, and biomass only had two responses. One firm identified as being in all four renewable fields, another was in three fields, and two firms stated they were in two of the fields. Three respondents were not sure if their company were in the market.

Three respondents stated “Other” and listed these as being as followed:” provider of parts to automotive market that produces “green” vehicles,” “our company manufactures energy efficient residential windows,” and “design, build, and test demand response equipment to help reduce building energy consumption.” All other respondents (13) stated they were not producing in the renewable energy component market.

Responses were almost evenly split between the three options of “Yes,” “No,” and “Not sure/don’t know” when respondents were asked if their company was aware of being identified as a possible renewable energy component supplier of those who had stated they were not currently. Nine respondents answered their company was aware, while the two other options of “No” or “Not sure/don’t know” garnered eight responses each. For those currently producing components in the renewable market, the majority (4) were aware before the survey of the possibility of being a component supplier while the other two respondents were either not sure or stated their company was unaware before the survey. It may be considered that maybe this study was the first time of the company may have become aware of that possibility. However, one must also note that perhaps the respondent, though knowledgeable within their respected company may not be fully aware of their respected business ability and a different respondent from the same company may provide a different answer.

In attempts to establish a correlation, data was transferred over to SPSS© and a cross tabulation analysis was run using Fischer’s Exact Test. Fisher’s Exact Test was used due to the small sample size and to examine whether outside identification was accurate when compared to self-assessments of whether companies were engaged in the renewable energy component market. Fischer’s exact test has been cited as an ideal unbiased test to use for small sample sizes

where research is examining whether the presence of one variable has an impact on another nominal variable (Raymond & Rousset, 1994).

Fisher's exact test registered this being 0.287, or insignificant, between the two variables at a 0.05 alpha level. From this, again given the current sample size, it could be stated that no correlation exists between businesses being identified through REPP standards against self-identification using surveys. Because of this, the study has failed to reject the null hypothesis. The implications from this conclusion are that identification of a potential firm through REPP standards does not equate to the company having either capabilities, or the drive to enter the renewable energy component market. Future research in this subject may need a survey instrument to accurately portray the actual number of companies in the selected region or area who are in the renewable energy component market. It may also be reason to conclude that previous research in this area may need to be updated as previous methods may not have provided an accurate representation either.

5.3 Relationships between component manufacturers

An area of interest during the study was related to similarities and differences between those who stated they were in the renewable component market and others whom identified as potential suppliers in the market. Similarities and differences were examined when respondents were asked to gauge future challenges and reflect on what skills are needed for the field.

For job skills, it was recorded that the overwhelming favorite for how to train employees was by using in-house training or on-the-job training. One difference that was noticeable was in regard to those in the "other" market for renewable components stated they all believed that industry-recognized green certification training was needed. This was interesting because no respondent in or outside of producing renewable components believed this was important.

Another surprising difference was in relation to the emphasis of a college degree or community college courses. The only renewable energy component producer that believed this was needed was in hydroelectric. This is something to note for potential future research, perhaps using a larger sample size to examine whether more respondents would have a different preference for higher education's involvement in preparing current and future employees.

When presented with future challenges in the field it seemed small differences existed between the differing respondents. For example, when asked about workforce availability all groups rated this issue as a challenge to an extent. It was also interesting that when asked about the impact of federal and state policies on growing the market, the sector as a whole did not believe this to be an issue and even rated state policy as a lower concern than federal policy. However, it is also important to note that during the open response section, several respondents were vocal on federal policy being a possible concern due to the lack of a long-term strategic plan on how to efficiently adapt renewable energy into the infrastructure.

One trend noticeable throughout the study centered on who those that identified their companies in the "other" renewable component market usually ranked issues as more challenging than any of the other groups. This segment was more likely to state that federal and state policy would be challenging in expanding the renewable market, a mismatch existed of research and development capacity, and that underdeveloped supply chains would be an issue as well. From the breakdown of individual responses provided, it was noted that even though these companies did not actively produce renewable components, they were documented to have an imprint in the renewable energy field as one rep stated the involvement of their product into green vehicles as an example.

Regarding the role of politics, it was intriguing that even though federal and state policies were rated as not being a challenge, later in the survey when respondents were asked to identify potential economic development support for the industry two of the top three replies were related to politics. These two cited responses were the "need for a formalized strategic plan needed for growing the market by the state" as well as "meeting with politicians to discuss challenges and opportunities within the field." Slightly under half of respondents noted the need to meet with policy makers. Again, these responses are in contrast to earlier questioning where federal and state policy was rated lower on potential barriers.

5.4 Relationships between counties

Relationships between counties was an area of interest to this study especially due to one county in the region, Fayette, which the second largest city in the state. Because of the heavy urbanization of this county when compared to the neighboring counties, it could have been assumed that possible significant differences would have been found in relation to viewpoints of industries in Fayette County in comparison of neighboring industries. At times during this study it did seem that some differences were shown between Fayette and its neighboring counties. One example was in reference to the challenge of possible investment capital to grow the market. While Fayette County did not view this as a challenge, four of the other counties did, with two of these counties even falling into what was considered moderate challenge category.

However, there were other instances where surrounding counties had contrasting views when compared to the region as a whole. In particular, Scott County viewed both workforce availability and mismatch of research and development capacity as not a challenge at all when compared to its peers. Clark County was the only county to view both federal and state policies

as a moderate challenge in growing the market. Overall, it was surprising that the majority of the time counties were often closely aligned on viewpoints regarding potential issues and barriers.

CHAPTER 6 CONCLUSIONS AND RECOMMENDATIONS

6.1 Recommendations

This study was limited in several ways and further research could be expanded upon in the future. First, this study was limited to the Bluegrass Region due to the limited resources of only one researcher over the study. Future research of this study would include either another researcher or more time so that the possibility of expanding the survey to the entire state could be conducted. Expanding the study to the rest of the state would increase the sample size and research could then be conducted regarding similarities and differences between regions.

Further research may also provide a better analysis of how many companies in the state are producers of renewable energy components based on the set forth methodology. In the current state, it does appear that identification through REPP standards does not necessarily mean a company is engaged in the market. By increasing the sample size other areas of interest may have further clarification, for instance the view of current training methods and whether more companies would have a higher emphasis on higher education than what is currently stated in this study. That was one area of interest that came as surprising when completing this study.

It is also important to note that this study focused solely on renewable energy component manufacturing. Because coal encompasses much of the energy portfolio of Kentucky, future research may use this study as a baseline to research possible component manufacturers in the "clean coal" market. This study could also be relevant to the existing coal market in utilizing local businesses for potential parts needed within the coal supply chain.

Another area for future research could be in regard to the view of considering government policy as a challenge for growth. Again, with this being one small segment of the state, it would be interesting to examine how other regions and counties view the impact of government policy.

Trends that may be seen could be that certain industries and regions would place greater or less emphasis than current findings. It may also enhance the feedback regarding the impact of state versus federal policy as a potential barrier for the renewable energy market.

The recommendation for expanding this study to the entire state to increase sample size (and have more conclusive data) is a major recommendation of this study. In the current findings, the researcher had to record respondents' words for the views of the company they represented, which means they represented the counties they reported from as well. Due to the small sample size, current inferences may change or be reaffirmed with more sample points for comparison.

Regarding surveying methods, it is in this researcher's opinion that the data collection method of using Qualtrics© and providing a survey link via internet and email, was a more than adequate way of collecting data. During several initial conversations with respondents on the phone regarding participation, respondent stated they did not have time to complete a phone interview, but when informed the survey was an anonymous online survey would change their mind and provide an email address to complete the survey. Survey response rates from this method registered at 52% which is relatively high for an online survey.

6.2 Conclusion

Because previous studies used solely REPP standard identification as a means to understand the renewable energy component market and potential players, this study delved further by examining if that method could adequately account for companies in the market. In this particular study, it was shown that no correlation existed. It is possible that if this was replicated with a larger sample size or even in another area within the state, that results may be different. There also exists the chance that by having more data for this study that the findings in

this research would be reinforced. It is in this researcher's opinion that in an ideal situation identification presented in this methodology would be used and followed up with either the same or a similar survey.

More importantly though, this study served its purpose in bringing new data and a potential new method to this particular area of study. As stated previously, no research exists in this detail for the state of Kentucky or this region. This study was the first of its nature to understand how to best identify potential producers of renewable energy component companies, along with views on challenges related to the market from first-hand business representatives collected by the researcher.

Data collected from this study could be beneficial to multiple stakeholders such as: potential businesses, current businesses, government representatives, or others in academia. Further research could be undertaken to expand on current findings and present new ones for a market that is expected to continue to grow well into the future. In relation to the area studied, it may aid businesses in examining their current and future strategic plans, especially for those who identified they were not previously aware of the possibility of becoming a supplier in renewable energy component manufacturing. Local and state governments may create policies that are more beneficial to the renewable energy market as a whole. Finally, those in academia and other researchers may view this study as a guideline for replication in their own studies within their own respective regions and states.

APPENDIX A

The relevant NAICS codes identified by REPP included:

A. Wind	
326199	All Other Plastics Products
331511	Iron Foundries
332312	Fabricated Structural Metal
332991	Ball & Roller Bearing
333412	Industrial & Commercial Fans and Blowers
333611	Turbine and Turbine Generator Set Units
333612	Speed Changer, Drive & Gear
333613	Mechanical Power Transmission Equipment
334418	Printed Circuits & Electronics Assemblies*
334519	Measuring & Controlling Devices
335312	Motors & Generators
335999	Electronic Equipment & Components, Misc.
B. Solar	
325211	Plastics Material & Resin
326113	Unlaminated Plastics Film & Sheet (except Packaging)
327211	Flat Glass
331422	Copper Wire (except Mechanical) Drawing*
332322	Sheet Metal Work
334413	Semiconductors & Related Devices
334515	Instruments Measuring & Testing Elec.Signals
335313	Switchgear & Switchboard Apparatus
335911	Storage Batteries
335931	Current-Carrying Wiring Devices
335999	Electronic Equipment and Components, Misc.
C. Biomass	
327993	Mineral Wool
331210	Iron, Steel Pipe & Tube from Purchased Steel
332410	Power Boiler & Heat Exchanger
332420	Metal Tank (Heavy Gauge)
332911	Industrial Valve
333120	Construction Machinery
333210	Sawmill & Woodworking Machinery
333411	Air Purification Equipment
333414	Heating Equipment (except Warm Air Furnaces)
333415	AC & Warm Air Heating Equip& Comm & Ind Ref
333911	Pump & Pumping Equipment
333912	Air & Gas Compressor
333922	Conveyor & Conveying Equipment
333923	Overhead Traveling Crane, Hoist & Monorail System
333999	General Purpose Machinery, Misc.
334513	Instruments and Related Prod for Measuring, Displaying,
335311	Power, Distribution, and Specialty Transformer

335999	Electronic Equipment & Components, Misc.
336510	Railroad Rolling Stock

D. Geothermal

331210	Iron, Steel Pipe & Tube from Purchased Steel
332410	Power Boiler & Heat Exchanger
332420	Metal Tank (Heavy Gauge)
333415	Air Heating Equip & Comm & Ind Ref. Equip Mfg.
333911	Pump & Pumping Equipment
333912	Air & Gas Compressor
333923	Overhead Traveling Crane, Hoist & Monorail System

APPENDIX B

PURDUE
UNIVERSITY

PURDUE POLYTECHNIC INSTITUTE
Department of Technology Leadership & Innovation

Dear Participant:

My name is Scott Abney and I am a Kentucky native as well as a Ph.D. student at Purdue University seeking your assistance. Your company has been identified as potentially being a supplier for renewable energy components for Kentucky manufacturing around the Bluegrass Region. Further development of a "green" economy is an opportunity for Kentucky manufacturing industries to attract new investments, create new jobs, and diversify the state economy. I am writing because I am conducting a brief survey regarding your opinions of workforce and manufacturing development in the production of green products and services. Participation in the survey is completely voluntarily; however, those who do participate will receive a summary of findings from the data collected.

This survey will take about 10 minutes to complete and all information will be kept completely confidential. A definition list has been included to assist in the answering and clarification of terms. During the survey you may stop or refuse to answer questions at any time. If you have questions regarding the survey please feel free to contact me (859-749-3299), or my Ph.D. Advisor, Dr. Kathy Newton (765-494-6875).

Thank You,

Scott Abney

Start of Block: Default Question Block

Thank you for taking the time to complete this survey. Below are terms that are used throughout the survey along with definitions to provide clarification in assisting the completion of the survey

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Department of Technology Leadership & Innovation

Energy Production-Green Energy is the conversion from conventional sources of energy to the technology and development of renewable, clean energy sources. The Green Energy industry includes jobs found in energy production and generation activities, power distribution and plant operations, turbine power generation, installation, repair and electronics for windmills, and bio-fuel manufacturing. Examples of job titles can include: Green Engineering Manager, Green Mechanical Engineer, Smart Grid Hardware Engineer, among others.

Green Building- Green Building uses environmentally friendly materials and methods for residential and non-residential infrastructure. Other aspects of Green Building include: converting existing property to lessen negative impacts on the environment, converting sustainable or renewable sources into energy, and replenishing resources such as water and oxygen. The Green Building industry includes jobs typically found in construction related activities, house shell manufacturing, household appliance manufacturing, design and remodeling services, and remediation services. Examples of job titles can include: Construction Laborers, Construction Managers, Architect, HVAC installers, among others.

Green Manufacturing- The Green Manufacturing industry includes jobs found in engineering, research and development firms, and across nearly all manufacturing sectors. Jobs in this sector include those involved in the research, development, and production of materials, parts, and final products within the following categories: energy efficiency, renewable energy, and safety. Examples of job titles can include: Production Manager, Quality Control Inspector, Materials Engineer, Industrial Engineer, among others

Green Farming- The Green Farming industry includes jobs found in agriculture and forestry. Green farming represents jobs in crop production for bio-fuels as well as organic farms and Forest Stewardship Council certified foresters. Other jobs found in agriculture and forestry consist in the areas of: organic/free range food production, forest preservation, and renewable energy resource production. Job titles can include: Farm Mangers, Farm Operators, Federal Organic Farm Specialist, among others.

Green Public Administration- The Green Public Administration industry includes jobs typically found in local, state, and federal government or in contracts related to government policy. Examples of these activities include the execution, oversight, and operational management of public policy in the areas of environmental conservation, green building, resource management, and energy. Job titles include: Urban Planning Assistant, Arbitrator, Land Use Planner, City Manager, among others.

Green Salvage/Remediation- The Green Salvage/Remediation industry includes jobs found in waste management, environmental engineering, chemistry, salvage, and maintenance occupations. Examples of these activities include the process of renewing resources through: material extraction, environmental cleanup, re-use, and product conversion. Job titles may include: Compliance Officers, Cost Estimators, Natural Science Manager, Conservation Scientist, among others.

How many employees work at this business? (Do NOT include consultants, outside contractors, vendors, and others who are not to be considered employees)

- ○ (0) Less than one (1)
- ○ (1-100) number of employees in business (2)
- ○ (101-500) (3)
- ○ (501-1000) (4)
- ○ (1001) More than 1000 (5)
- ○ (8888) Don’t know/not sure (6)
- ○ (9999) Refuse (7)

Differing Question: Does your business currently provide goods or services in any of the following "green sectors"? [READ ALL and Check all that apply]

- [ ] Energy Production (1)
- [ ] Green Building (2)
- [ ] Green Manufacturing (3)
- [ ] Green Farming (4)
- [ ] Green Public Administration (5)
- [ ] Green Salvage/Remediation (6)
- [ ] None of the above (7)
- [ ] No (8)

Does your company have any plans in the next 1-3 years to do so?

- ○ Yes (1)
- ○ No (2)
- ○ Don't know/not sure (3)
- ○ Refuse to answer (4)

If Yes, which sector [Check all that apply]

- ☐ Energy Production (1)
- ☐ Green Building (2)
- ☐ Green Manufacturing (3)
- ☐ Green Farming (4)
- ☐ Green Public Administration (5)
- ☐ Green Salvage/Remediation (6)
- ☐ None of the above (7)

Does your business currently produce component parts for any of the following renewable energy markets? [Check all that apply]

- ☐ Solar (1)
- ☐ Wind (2)
- ☐ Biomass (3)
- ☐ Hydroelectric (4)
- ☐ Other (5)
- ☐ Not Sure/Don’t Know (6)
- ☐ None of the above (7)

If "Other" is selected, please explain

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_____

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_____

Before this survey, was your company aware of being identified as a possible renewable energy component supplier?

- ○ Yes (1)
- ○ No (2)
- ○ Not Sure/Don't Know (3)

Differing question: Are any of the following methods used at your business to prepare current workers to produce green products or services? [Read and check all that apply]

- ☐ In house classroom/on-the-job training (1)
- ☐ Industry-recognized green certification or training (2)
- ☐ Apprenticeship programs (3)
- ☐ Hire only workers who are already trained (4)
- ☐ Community College courses (5)
- ☐ College Degree (AA/AS or above) (6)
- ☐ Others (7)

☐ Don’t Know/Not Sure (8)

☐ None (9)

☐ Refuse (10)

If "Others" is selected please explain

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_____

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What new skills or knowledge will future employees need to perform work activities at your business? [Read and check all that apply]

- ☐ Principles of energy conservation (1)
- ☐ Waste minimization (2)
- ☐ Pollution reduction and control (3)
- ☐ Vehicle technology/maintenance (4)
- ☐ Information technology (5)
- ☐ Alternative energy (6)
- ☐ Others (7)
- ☐ Don’t know/not sure (8)
- ☐ Refuse (9)

If "Others" is selected please explain

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_____

On a scale from 0-10 with 0 being "Not Challenging" and 10 being "Extremely Challenging" How challenging are the following issues in your view for growth of the renewable energy field?

Lack of investment capital or financing (funding)

- ○ 0 (0)
- ○ 1 (1)
- ○ 2 (2)
- ○ 3 (3)
- ○ 4 (4)
- ○ 5 (5)
- ○ 6 (6)
- ○ 7 (7)
- ○ 8 (8)
- ○ 9 (9)
- ○ 10 (10)

State government policy and regulations

- ○ 0 (0)
- ○ 1 (1)
- ○ 2 (2)
- ○ 3 (3)
- ○ 4 (4)
- ○ 5 (5)
- ○ 6 (6)
- ○ 7 (7)
- ○ 8 (8)
- ○ 9 (9)
- ○ 10 (10)

Federal government policy and regulations

- ○ 0 (0)
- ○ 1 (1)
- ○ 2 (2)
- ○ 3 (3)
- ○ 4 (4)
- ○ 5 (5)
- ○ 6 (6)
- ○ 7 (7)
- ○ 8 (8)
- ○ 9 (9)
- ○ 10 (10)

Underdeveloped renewable energy supply chains (logistics & transportation included)

- ○ 0 (0)
- ○ 1 (1)
- ○ 2 (2)
- ○ 3 (3)
- ○ 4 (4)
- ○ 5 (5)
- ○ 6 (6)
- ○ 7 (7)
- ○ 8 (8)
- ○ 9 (9)
- ○ 10 (10)

Mismatch of instate research and development capacity

- ○ 0 (0)
- ○ 1 (1)
- ○ 2 (2)
- ○ 3 (3)
- ○ 4 (4)
- ○ 5 (5)
- ○ 6 (6)
- ○ 7 (7)
- ○ 8 (8)
- ○ 9 (9)
- ○ 10 (10)

Workforce availability

- ○ 0 (0)
- ○ 1 (1)
- ○ 2 (2)
- ○ 3 (3)
- ○ 4 (4)
- ○ 5 (5)
- ○ 6 (6)
- ○ 7 (7)
- ○ 8 (8)
- ○ 9 (9)
- ○ 10 (10)

What are the biggest challenges related to workforce needs and/or availability?

_____

_____

_____

_____

_____

What potential economic development support would help your company to grow in the renewable energy field? [Read and check all that apply]

- [ ] Formalized strategic plan for growing renewable energy in the state (1)
- [ ] Meeting with state/local policymakers on opportunities/challenges for renewable energy growth (2)
- [ ] Meetings with utility regulators about the opportunities and challenges for renewable energy growth (3)
- [ ] Meetings with renewable energy venture capitalists (4)
- [ ] Analysis of the workforces' needs of renewable energy or efficiency businesses (5)
- [ ] Don't know/not sure (6)
- [ ] Refuse (7)
- [ ] None of the above (8)

Is there anything else you would like to share or elaborate on regarding your experience with the renewable energy field and market?

_____

_____

_____

_____

_____

APPENDIX C

*Denotes response to survey

Company Name	County	Business	NAICS Codes	Description	Renewable Field
Harry Gordon Steel*	Clark	steel fabricating	332312	Copper Wire (except Mechanical) Drawing	Wind
Infiltrator Water Tech*	Clark	waste water	326199	All Other Plastics Products	Wind
Jennmar of KY	Clark	mining	332312	Copper Wire (except Mechanical) Drawing	Wind
Jennmar of KY	Clark	mining	336510	Overhead Traveling Crane, Hoist, & Monorail System	Biomass
Niles America Wintech*	Clark	injection molding	326199	All Other Plastics Products	Wind
Niles America Wintech*	Clark	injection molding	335931	Overhead Traveling Crane, Hoist, & Monorail System	Solar
Sekisui	Clark	automotive. reforest BG	325211	Plastics Material & Resin	Solar
3M Ceradyne INC*	Fayette	ceramics	334413	Overhead Traveling Crane,	Solar

				Hoist, & Monorail System	
Blue Star Plastics INC	Fayette	plastic injection	326199	All Other Plastics Products	Wind
Contract Machining & Manufacturing*	Fayette	machining	332420	Sheet Metal Work	Geothermal
Contract Machining & Manufacturing*	Fayette	machining	332420	Sheet Metal Work	Biomass
Fab Steel INC	Fayette	steel fabricating	332312	Copper Wire (except Mechanical) Drawing	Wind
Foam Designs INC	Fayette	foam	326199	All Other Plastics Products	Wind
Foam Designs INC	Fayette	foam	325211	Plastics Material & Resin	Solar
Honeycutt Mechanical Contractors INC*	Fayette	sheet metal	332322	Sheet Metal Work	Solar
Imperial Tool & Manufacturing Co Inc	Fayette	molds	326199	All Other Plastics Products	Wind
Intelligent Products Co*	Fayette	Industrial controls	334513	Overhead Traveling Crane, Hoist, & Monorail System	Biomass
ITW Powertrain Fastening*	Fayette	fasteners	326199	All Other Plastics Products	Wind

Kinemetrix Industrial Design INC*	Fayette	automation	332911	Sheet Metal Work	Biomass
Lexington Dixie Plant	Fayette	plastic lids	326199	All Other Plastics Products	Wind
LexPlastics	Fayette	custom	326199	All Other Plastics Products	Wind
Link Belt Construction*	Fayette	cranes	333120	Sheet Metal Work	Biomass
MMI Of KY	Fayette	concrete	332312	Copper Wire (except Mechanical) Drawing	Wind
Molding Solutions INC*	Fayette	molds	326199	All Other Plastics Products	Wind
Point Six Inc	Fayette	propotype	334418	Overhead Traveling Crane, Hoist, & Monorail System	Wind
Rogers Windows Inc*	Fayette	windows	326199	All Other Plastics Products	Wind
Southern Tent	Fayette	awnings	326199	All Other Plastics Products	Wind
Ruskin*	Fayette	fans	332322	Sheet Metal Work	Solar
Schneider Electric*	Fayette	safety switches	335313	Overhead Traveling Crane, Hoist, & Monorail System	Solar

Semicon Associates	Fayette	tubes	334413	Overhead Traveling Crane, Hoist, & Monorail System	Solar
AEP Industries*	Jessamine	packaging	326199	All Other Plastics Products	Wind
AEP Industries*	Jessamine	packaging	326113	Unlaminated Plastics Film & Sheet	Solar
CW Assemblies LLC	Jessamine	system integration	335999	Overhead Traveling Crane, Hoist, & Monorail System	Wind
McKechnie Vehicle*	Jessamine	molding and components	326199	All Other Plastics Products	Wind
SMC LLC	Jessamine	electronics	334418	Overhead Traveling Crane, Hoist, & Monorail System	Wind
Sterling Tool & Die	Jessamine	Fabrication	332322	Sheet Metal Work	Solar
AGC Glass Co NA*	Madison	automotive	327211	Flat Glass	Solar
Bluegrass Wire Technologies	Madison	forklift wire harness	335312	Overhead Traveling Crane, Hoist, & Monorail System	Wind
Bluegrass Wire Technologies	Madison	forklift wire harness	335312	Overhead Traveling Crane, Hoist, & Monorail System	Wind

Brown & Tribble INC*	Madison	sheet metal	332322	Sheet Metal Work	Solar
EnerSys*	Madison	industrial batteries	335911	Overhead Traveling Crane, Hoist, & Monorail System	Solar
Hitachi Automotive Systems Americas INC (Richmond)*	Madison	brake and suspensions assembly	333912	Air & Gas Compressor	Biomass
Hitachi Automotive Systems Americas (Berea) INC*	Madison	brake and suspensions assembly	333912	Air & Gas Compressor	Geothermal
Metcalf Metal Inc	Madison	steel fabricating	332312	Copper Wire (except Mechanical) Drawing	Wind
Middletown Metal Works INC	Madison	fabrication	332322	Sheet Metal Work	Solar
Sherwin-Williams*	Madison	paint	325211	Plastics Material & Resin	Solar
Tebco of KY	Madison	truck parts	332312	Copper Wire (except Mechanical) Drawing	Wind
Quanex Building Products	Madison	vinyl for windows	326199	All Other Plastics Products	Wind
Action Equipment Solutions*	Scott	design and engineering	335999	Overhead Traveling Crane, Hoist, & Monorail System	Wind

Action Equipment Solutions*	Scott	design and engineering	335999	Overhead Traveling Crane, Hoist, & Monorail System	Solar
Action Equipment Solutions*	Scott	design and engineering	333922	Air & Gas Compressor	Biomass
Action Equipment Solutions*	Scott	design and engineering	335999	Overhead Traveling Crane, Hoist, & Monorail System	Biomass
D&R Metal Fab INC	Scott	sheel metal fabrication	332322	Sheet Metal Work	Solar
Georgetown Tool &Manufacturing INC	Scott	machine shop	333999	Overhead Traveling Crane, Hoist, & Monorail System	Biomass
Toyota Tsusho America*	Scott	logistics	332312	Copper Wire (except Mechanical) Drawing	Wind
Qualex Manufacturing LLC*	Scott	sheet metal	332322	Sheet Metal Work	Solar
Nisshin Automotive Tubing LLC	Woodford	steel tubing	331210	Flat Glass	Biomass
Nisshin Automotive Tubing LLC	Woodford	steel tubing	331210	Flat Glass	Geothermal
Yokohama Industries Americas*	Woodford	hoses	333415	AC & Warm Air Heating Equip & Comm & Ind Ref	Biomass

Yokohama Industries Americas*	Woodford	hoses	333415	AC & Warm Air Heating Equip & Comm & Ind Ref	Geothermal

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