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December 13, 2017

Asim Z. Haque  
Chairman, Public Utilities Commission of Ohio  
Public Utilities Commission of Ohio  
180 East Broad Street  
Columbus Ohio 43215-3793

*Re: In the Matter of Ohio Power Company's Generation  
Transition Docket, Case No. 17-882-EL-UNC*

**Steven T. Nourse**  
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Dear Chairman Haque:

On behalf of Ohio Power Company (AEP Ohio), I am submitting the enclosed report entitled "Ohio Renewable Energy Manufacturing & Company Establishment Analysis" conducted by Navigant Consulting, Inc. Submittal of this report fulfills Paragraph III.D.12.e of the Joint Stipulation and Recommendation in Case Nos. 14-1693-EL-RDR and 14-1694-EL-AAM (PPA Rider Stipulation). The report will also be referenced in the Company's 2018 annual update filing, but the Company wanted to submit it now since it is already completed.

Thank you for your attention to this matter.

Respectfully Submitted,

//s/ Steven T. Nourse

cc: Parties of Record

# Ohio Renewable Energy Manufacturing & Company Establishment Analysis

Prepared for:  
AEP Ohio



## FINAL

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December 13, 2017

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## DISCLAIMER

This report was prepared by Navigant Consulting, Inc. (Navigant) for AEP Ohio. The work presented in this report represents Navigant's professional judgment based on the information available at the time this report was prepared. Navigant is not responsible for the reader's use of, or reliance upon, the report, nor any decisions based on the report. **NAVIGANT MAKES NO REPRESENTATIONS OR WARRANTIES, EXPRESSED OR IMPLIED.** Readers of the report are advised that they assume all liabilities incurred by them, or third parties, as a result of their reliance on the report, or the data, information, findings and opinions contained in the report.

## EXECUTIVE SUMMARY

### BACKGROUND

In PPA Stipulation Section III.D.12. e., the Public Utilities Commission of Ohio (PUCO) directed AEP Ohio to “perform an analysis about how to bring or encourage companies to establish renewable energy companies with headquarters and manufacturing plants in Ohio and how to transition the current power plant workforce to such job opportunities.”<sup>1</sup> AEP Ohio retained Navigant, an independent third party, to conduct this analysis. Navigant completed six tasks with the goal of providing actionable strategies for achieving the goals outlined in the stipulation.

**Table E-1. Task Goals**

Project Task	Task Goal
1. Initiate Project	Confirm project goals and define communication plans.
2. Develop Company Motivators	Catalog the reasons why renewable energy companies locate where they do and rank them in order of importance.
3. Define State Strategies	Characterize the different strategies used by states and discuss their relative success.
4. Assess in Ohio	Establish a baseline number and type of renewable energy companies already in Ohio.
5. Map Career Transitions	Define pathways for existing conventional power plant workers to move into the renewable energy industry as jobs decline in conventional power plants.
6. Develop Recommendations & Findings	Develop high-impact, feasible options for the state of Ohio to encourage renewable energy companies and manufacturers to set up headquarters in Ohio.

This report details the research and findings of Navigant’s analysis and provides a roadmap for encouraging renewable energy companies to establish in or locate to Ohio while also providing pathways for power plant workers to transition into these opportunities.

### RENEWABLE ENERGY COMPANY MOTIVATORS

Navigant began this study by determining the factors that drive renewable energy development and services companies and manufacturers to locate headquarters or manufacturing facilities in a certain area. Navigant developed a six-category framework that significantly affect different operational factors and ultimately influence locational decisions, ranking these locational motivators for both renewable companies focused on development and services and manufacturers. These factors serve as levers for states to pull to drive regional renewable energy company growth.

<sup>1</sup>Public Utilities Commission of Ohio, Opinion and Order, Case No. 14-1693-EL-RDR and Case No. 14-1694-EL-AAM, PPA Stipulation Section III.D.12.e.

**Figure E-1. Renewable Energy Company & Manufacturer Locational Motivators**



## STATE STRATEGIES

Navigant characterized strategies used by states to target companies and manufacturers and discussed each strategies' relative success. This analysis resulted in four overarching themes.

**Figure E-2. State Strategies Framework**



Based on our analysis, Navigant focused on incentives and policy and created a scoring system to assess wind and solar strategies by state and determine whether there was a correlation between these strategies and the number of solar and wind jobs per state. From this analysis, the team verified that policies, such as RPS, Net Metering, third-party PPAs, and financial incentives, in addition to solar resource availability and high electric rates, play a large role in driving solar jobs at the state level. Meanwhile policies and financial incentives play a less significant role in the growth of wind jobs, due in large part to the types of wind jobs available.

## ASSESS OHIO

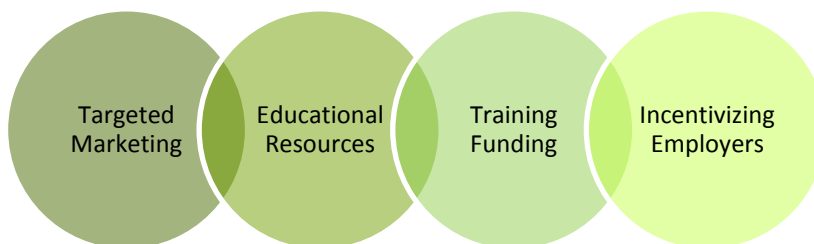
Navigant assessed the current state of jobs and companies in Ohio, aimed at establishing a baseline for the renewable energy companies in Ohio and helping Navigant target its findings and recommendations to allow for sustained renewable energy company and job growth. Our analysis found that many companies of different sizes and types are currently operating in Ohio.

## MAP CAREER TRANSITION

Navigant examined strategies for the state of Ohio to facilitate employee transition to renewable energy opportunities as they arise. Based on the research and resources available, Navigant developed a pathway for transitioning from a conventional power plant career to a renewable energy career. Navigant

identified four strategies that key stakeholders can enact. The strategies are intended to work in conjunction, utilizing different levers for helping conventional power plant workers transition.

**Figure E-3. Strategies for Facilitating Career Transition**



## FINDINGS & RECOMMENDATIONS

Navigant developed four guiding principles for implementing strategies to grow a localized renewable energy market, increasing the number of companies and jobs within the state. The guiding principles were: market stability, consistent programs, workforce preparation, and research and development. Using these principles, Navigant developed five actionable recommendations for the state and local governments to implement to drive renewable energy company and job growth. Table E-2 lists the recommendations.

**Table E-2. Study Recommendations**

Number	Recommendation
1	Publish multi-year state renewable energy procurement plan, led by the state or a state-wide body.
2	Expand JobsOhio to include: <ul style="list-style-type: none"> <li>Renewable energy education platform providing career transition resources.</li> <li>Concierge service to answer renewable energy questions.</li> </ul>
3	Remove permitting barriers.
4	Invest in Research & Development.
5	Continue to invest in roads and infrastructure.



## 1. INTRODUCTION

### 1.1 STUDY BACKGROUND

In PPA Stipulation Section III.D.12. e., the PUCO directed AEP Ohio to “perform an analysis about how to bring or encourage companies to establish renewable energy companies with headquarters and manufacturing plants in Ohio and how to transition the current power plant workforce to such job opportunities.”<sup>2</sup> AEP Ohio retained Navigant, an independent third party, to conduct this analysis.

This report lays out the findings from the study, providing an in-depth overview of why renewable energy companies establish in specific locations, strategies for attracting these companies, and how different stakeholders can participate in the transitioning of conventional power plant workers to renewable energy opportunities. Ultimately, the analysis serves as a roadmap for encouraging renewable energy companies, particularly in the wind and solar industry, to establish in Ohio and for training and connecting workers to renewable energy opportunities as they arise.

### 1.2 STUDY GOALS

To provide actionable recommendations, Navigant created a list of questions to guide the analysis. The questions centered on renewable energy company motivators, existing strategies for encouraging regional renewable energy development (and therefore driving regional company location), and pathways for transitioning conventional power plant workers to renewable energy careers. The list below provides these questions.

- What are the factors that drive companies to locate headquarters or manufacturing facilities?
- What strategies do other states use to encourage companies to locate in their state?
- What renewable energy companies currently have headquarters or manufacturing in Ohio?
- And what attracted these companies to locate operations in Ohio or to leave Ohio?
- How can the current power plant workforce transition to work in the renewable energy industry?
- What actions should Ohio take to encourage renewable energy companies to set up headquarters in Ohio?

Based on these questions, Navigant developed a framework of six tasks to explore and answer the questions outlined above, ultimately providing actionable strategies for AEP Ohio and the state of Ohio. Table 1-1 below provides an overview of Navigant’s framework.

**Table 1-1. Task Goals**

Project Task	Task Goal
1. Initiate Project	Confirm project goals and define communication plans.
2. Develop Company Motivators	Catalog the reasons why renewable energy companies locate where they do and rank them in order of importance.

<sup>2</sup> Public Utilities Commission of Ohio, Opinion and Order, Case No. 14-1693-EL-RDR and Case No. 14-1694-EL-AAM, PPA Stipulation Section III.D.12.e.

3. Define State Strategies	Characterize the different strategies used by states and discuss their relative success.
4. Assess Ohio	Establish a baseline number and type of renewable energy companies already in Ohio.
5. Map Career Transitions	Define pathways for existing conventional power plant workers to move into the renewable energy industry as jobs decline in conventional power plants.
6. Develop Recommendations & Findings	Develop high-impact, feasible options for the state of Ohio to encourage renewable energy companies and manufacturers to set up headquarters in Ohio.

### 1.3 REPORT ORGANIZATION

Navigant organized the report to align to the study goals and tasks:

- **Section 2: Company Motivators** – Research and resulting framework for why companies locate where they do.
- **Section 3: State Strategies** – Outline and relative success rank of state strategies for encouraging regional growth or renewable energy companies.
- **Section 4: Assess Ohio** – Definition of solar and wind value chains and map of solar and wind companies located in Ohio.
- **Section 5: Map Career Transitions** – Pathway and strategies to help existing power plant workers transition to the renewable energy industry.
- **Section 6: Findings & Recommendations** – Actionable strategies for the state of Ohio to consider increasing the development of renewable energy companies in the State.

The report includes 2 appendices, which provide additional information:

- Case study key takeaways from renewable energy companies on locational decision-making and stakeholder recommendations.
- Resources for transitioning conventional power plant workers to renewable energy jobs, mentioned in Section 5, Renewable Energy Career Transitioning.

## 2. COMPANY MOTIVATORS

Navigant began this study by determining the factors that drive renewable energy development and services companies and manufacturers to locate headquarters or manufacturing facilities in a certain area, ranking these locational motivators. Navigant gained an understanding of locational motivators and how they align to various state strategies for the regional development of renewable energy manufacturers and companies. The findings ultimately resulted in valuable insight into how renewable energy companies may react to proposed strategies. Figure 2-1 illustrates the overarching locational motivators Navigant identified. This section explains the approach and key resources and provides details on the findings.

**Figure 2-1. Renewable Energy Company & Manufacturer Locational Motivators**



*Source: Navigant 2017*

### 2.1 APPROACH

Navigant used a four-step approach to identify, prioritize, and validate the top locational motivators for renewable energy companies and manufacturers. The steps include: conducting general research, brainstorming the initial list of drivers, prioritizing the drivers, and validating the prioritization through additional primary and secondary research. The first step involved examining national and global studies related to regional development as well as measures of “competitiveness” that influence market growth in a specific region. This step yielded a comprehensive catalog of drivers that influence companies and/or manufacturers picking one location over another. Navigant then translated this catalog into overarching categories, leveraging the team’s expertise in renewable energy and past Navigant studies. Following the finalization of the locational motivator categories, the team created a qualitative prioritization framework based on renewable energy industry specific studies validating the prioritization through industry interviews and additional market research. The list below details the key sources used throughout the process.

- U.S. Government National Network for Manufacturing Innovation Report<sup>3</sup>
- World Economic Forum Studies<sup>4</sup>
- National Renewable Energy Laboratory (NREL) Studies<sup>5,6</sup>
- Deloitte's Global Manufacturing Competitiveness Index<sup>7</sup>
- Company Case Studies<sup>8</sup>
- Recent News Articles<sup>9, 10,11</sup>

## 2.2 FRAMEWORK

Navigant created a framework of locational motivators for renewable energy companies and manufacturers. The framework consists of six categories that significantly affect different operational factors and ultimately influence locational decisions. These factors serve as levers to pull to drive regional renewable energy company growth. Table 2-1 details the locational motivators framework for renewable energy companies and manufacturers.

*"Moved locations because we wanted to make this into a real business. To make an impact, we needed to be close to a large population."*  
– Dovetail Wind & Solar

<sup>3</sup> President's Council of Advisors on Science and Technology, Accelerating US Advanced Manufacturing, October 2014,

[https://obamawhitehouse.archives.gov/sites/default/files/microsites/ostp/PCAST/amp20\\_report\\_final.pdf](https://obamawhitehouse.archives.gov/sites/default/files/microsites/ostp/PCAST/amp20_report_final.pdf)

<sup>4</sup> World Economic Forum, The Future of Manufacturing: Opportunities Drive Economic Growth, 2012,

[http://www3.weforum.org/docs/WEF\\_MOB\\_FutureManufacturing\\_Report\\_2012.pdf](http://www3.weforum.org/docs/WEF_MOB_FutureManufacturing_Report_2012.pdf)

<sup>5</sup> NREL, Manufacturing Conditions in the Global Wind Industry, <https://www.nrel.gov/docs/fy14osti/60063.pdf>.

<sup>6</sup> NREL, Carbon Fiber Manufacturing Facility Siting, <https://www.nrel.gov/docs/fy17osti/66875.pdf>.

<sup>7</sup> Deloitte, 2016 Global Manufacturing Competitiveness Index, 2016,

<https://www2.deloitte.com/global/en/pages/manufacturing/articles/global-manufacturing-competitiveness-index.html>.

<sup>8</sup> See Appendix A for details.

<sup>9</sup> The Journal News, "Start-up Business for Water-Power Technology to Open in Hamilton", December 2013,

<http://www.journal-news.com/news/start-business-for-water-power-technology-open-hamilton/GSCQ3bLbOzaTrRGLDscYHM/>







<sup>10</sup> Toledo Blade, "Toledo Area Could Get Another Solar Plant with 600 Jobs", 2010,

<http://www.toledoblade.com/local/2010/10/15/Toledo-area-could-get-another-solar-plant-with-600-jobs.html>

<sup>11</sup> Smart Energy Decisions, "Renewable Energy Access Lures Facebook to Ohio", August 18, 2017,

[https://www.smartenergydecisions.com/blog/2017/08/18/renewable-energy-access-lures-facebook-to-ohio?contact\\_id=59160&inf\\_contact\\_key=f87cf785d4ce3888273549c39b9591175051586c7ca7f86891a0a3ada8f79751](https://www.smartenergydecisions.com/blog/2017/08/18/renewable-energy-access-lures-facebook-to-ohio?contact_id=59160&inf_contact_key=f87cf785d4ce3888273549c39b9591175051586c7ca7f86891a0a3ada8f79751)

**Table 2-1. Renewable Energy Company & Manufacturer Locational Motivators Framework**

Motivators	Description	Examples
<b>Renewable Energy Market</b> 	<p>The Renewable Energy Market encompasses the localized climate for building renewables, including policy, permitting, and financial factors. These factors can help reduce long term business and financial risks as well as improve the ease of project development.</p>	<ul style="list-style-type: none"> <li>• Project economics, including electric rates, renewable energy resource availability, and inexpensive land</li> <li>• Policy, including Renewable Portfolio Standards (RPS), Net Energy Metering (NEM), and Solar Renewable Energy Credits (RECs)</li> <li>• Supportive permitting and financing</li> </ul>
<b>Supportive Schemes</b> 	<p>Supportive Schemes include incentives for developing a renewable energy product. These schemes can tip the scales in favor of a location if they reduce costs or provide long-term advantages, such as low-cost, innovative R&amp;D opportunities.</p>	<ul style="list-style-type: none"> <li>• Investment in Research &amp; Development (R&amp;D)</li> <li>• Equipment / manufacturing incentives</li> <li>• Grants</li> </ul>
<b>Workforce</b> 	<p>Workforce incorporates various labor aspects, including worker preparedness, access to training or educational resources, and cost of labor.</p>	<ul style="list-style-type: none"> <li>• Education and training program accessibility</li> <li>• Specialized knowledge via universities</li> <li>• Inexpensive labor</li> </ul>
<b>Logistics</b> 	<p>Logistics encompass ease of access to a stable product or end-user market via transportation corridors or proximity.</p>	<ul style="list-style-type: none"> <li>• Infrastructure / distribution access</li> <li>• Proximity to stable market</li> </ul>
<b>Operating Expenses</b> 	<p>Operating expenses include the cost of doing business in a location.</p>	<ul style="list-style-type: none"> <li>• Inexpensive land</li> <li>• Electric rates</li> <li>• Facility rents</li> <li>• State and local taxes</li> </ul>
<b>Supply Chain</b> 	<p>Supply chain includes the entire product value chain.</p>	<ul style="list-style-type: none"> <li>• Supplier market</li> </ul>

Source: Navigant 2017

## 2.3 PRIORITIZATION

Using the framework described, Navigant investigated renewable energy-specific studies, recent company relocations, and firsthand case studies to prioritize each category. Navigant created two separate lists, one for general renewable energy companies and one for manufacturers of wind and

*"We knew within a fifteen-mile radius where we wanted to be... which is very close to the I-70/75 highway crossroads."* – Energy Optimizers, USA

solar products, due to differing needs for these businesses. For example, manufacturers need to be located near transportation corridors to move products from different factories for assembly or installation. Meanwhile, renewable energy developers or service firms may prioritize a location near an end-user market to sell their product. The prioritized lists in Table 2-2 represent the most influential drivers in renewable energy company and manufacturer decision-making. This list provides a pathway for determining actionable strategies to entice companies to locate in a certain area.

**Table 2-2. Renewable Energy Company and Manufacturer Prioritized Locational Motivators**

Rank	Company Locational Motivators	Manufacturer Locational Motivators
1	Renewable Energy Market	Workforce
2	Supportive Schemes	Logistics
3	Workforce	Supply Chain
4	Logistics	Operating Expenses
5	Supply Chain	Supportive Schemes
6	Operating Expenses	Renewable Energy Market

Source: Navigant 2017

## 3. STATE STRATEGIES

Navigant characterized strategies used by states to target companies and manufacturers and discussed each strategies' relative success. Task 3 leverages the findings from Task 2 to identify specific and actionable levers for sustained renewable energy company and job growth with the aim of understanding possible high-value strategies. Given that many states and counties have been targeting renewable energy companies and jobs for the last 10 to 15 years, Navigant focused on gaining an understanding of how these strategies have influenced the number of renewable energy jobs and companies to-date.

This analysis resulted in four overarching themes defined in Figure 3-1. The following section provides additional details about the approach for developing this framework and the success of these strategies.

**Figure 3-1. State Strategies Framework**



Source: Navigant 2017

### 3.1 APPROACH

Navigant conducted a three-phase approach which involved researching existing literature, identifying strategies, and evaluating each strategies' success. The process began with conducting a literature search incorporating case study details, trade industry information, current initiatives, and information from the Database of State Incentives for Renewables and Efficiency (DSIRE).<sup>12</sup> Like the locational driver analysis, the research yielded a catalog of strategies employed by states to draw renewable energy companies and jobs to their state. Due to the volume of strategies, Navigant grouped these findings by similarity to get an overview of the types of strategies available. Finally, the team evaluated the success of each of the strategies by assigning scores to them at the state level. These scores were then compared against the number of wind and solar jobs in that respective state to test the legitimacy of the scoring. The entire analysis leveraged the sources in the list below.

- NREL Studies<sup>13</sup>
- The Solar Foundation, SolSmart Initiative Funded by the Department of Energy (DOE)<sup>14</sup>
- Database of State Incentives for Renewables & Efficiency (DSIRE)<sup>15</sup>

<sup>12</sup> NC Clean Energy Technology Center, Database of State Incentives for Renewables and Efficiency (DSIRE), <http://www.dsireusa.org/>.

<sup>13</sup> NREL, The Role of State Policy in Renewable Energy Development, July 2009, <https://www.nrel.gov/docs/fy09osti/45971.pdf>.

<sup>14</sup> The Solar Foundation, SolSmart Initiative, <https://www.thesolarfoundation.org/policy-research/solsmart/>.



<sup>15</sup> NC Clean Energy Technology Center, Database of State Incentives for Renewables & Efficiency, <http://www.dsireusa.org/>.

- The Solar Foundation 2016 Solar Job Census<sup>16</sup>
- American Wind Energy Association State Fact Sheets<sup>17</sup>
- Existing Navigant Studies<sup>18</sup>
- Energy Information Administration, Electric Rates<sup>19</sup>

## 3.2 FRAMEWORK

Navigant's approach resulted in a four-category framework of strategies employed by states to incentivize companies and manufacturers to locate in and ultimately bring jobs to their state. This framework aims to explain strategies currently used, providing an overview of possibilities for the state of Ohio. Table 3-1 outlines the framework created.

**Table 3-1. State Strategies Framework**

Strategies	Description	Examples
 <p>Incentives</p>	<p>Incentive strategies encompass any method of reducing the cost of doing business.</p>	<ul style="list-style-type: none"> <li>• Tax credits</li> <li>• Rebates</li> <li>• Subsidies</li> <li>• Performance-based incentives</li> <li>• Grants</li> <li>• Loans</li> <li>• Employment Incentives</li> </ul>
 <p>Policy</p>	<p>Policy strategies include regulations that increase market certainty, reducing the risk and improving the ease of doing business within the state.</p>	<ul style="list-style-type: none"> <li>• Renewable Portfolio Standards (RPS)</li> <li>• Net Metering (NEM)</li> <li>• Renewable Energy Credits (RECS)</li> <li>• Green tariffs</li> <li>• Community development zones</li> <li>• Preferred or required local sourcing</li> </ul>



<sup>16</sup> The Solar Foundation, Solar Job Census 2016, <https://www.thesolarfoundation.org/national/>.

<sup>17</sup> American Wind Energy Association, US Wind Energy State Facts, <https://www.awea.org/resources/statefactsheets.aspx?itemnumber=890&navItemNumber=5067>.

<sup>18</sup> Navigant, Washington State Clean Energy Leadership Plan for the Washington Clean Energy Leadership Council, <http://www.efsec.wa.gov/Whistling%20Ridge/Adjudication/Intervenor's%20pre-filed%20testimony/Ex%2034-05.%20CELC%20extract.pdf>.

<sup>19</sup> Energy Information Administration, Table 5.6.A. Average Price of Electricity to Ultimate Customers by End-Use Sector, by State, July 2017 and 2016, July 2017, [https://www.eia.gov/electricity/monthly/epm\\_table\\_grapher.php?t=epmt\\_5\\_6\\_a](https://www.eia.gov/electricity/monthly/epm_table_grapher.php?t=epmt_5_6_a)



<p>Market Awareness</p> 	<p>Market awareness strategies encompass building a market for renewable energy by educating consumers, providing opportunities for projects (e.g. through project aggregation), and any other strategies that encourage end-users to partake in the industry.</p>	<ul style="list-style-type: none"> <li>• Market awareness education</li> <li>• Choices for customers (market access)</li> <li>• Local organizations/co-ops for project aggregation, policy lobbying, and market education</li> </ul>
<p>Company Support</p> 	<p>Customer support strategies include methods for supporting prospective renewable energy companies/employers. These strategies include funding as well as general assistance.</p>	<ul style="list-style-type: none"> <li>• Workforce training</li> <li>• Incentives for industry development</li> <li>• Employee search assistance</li> <li>• Property search assistance</li> <li>• Funding demonstration projects</li> <li>• Focus on building research, technology transfer, and university capabilities</li> </ul>

Source: Navigant 2017

### 3.3 STRATEGY EVALUATION

With the framework defined, Navigant focused on evaluating the success of the policy and incentive strategies, stemming from two recent reports from the National Renewable Energy Laboratory (NREL) and the Lawrence Berkeley National Laboratory (LBNL), industry-leading renewable energy research organizations. LBNL recently published its 2017 Annual Status Report of US Renewable Portfolio Standards, which included an analysis of the historical impacts of RPS on renewables development, concluding that “roughly half of all growth in US renewable electricity (RE) generation and capacity since 2000 is associated with state RPS requirements.”<sup>20</sup> Likewise a 2014 report from NREL came to a similar conclusion, finding that “niche incentives, only when layered on top of high quality market access policies, can support distributed generation penetration in target markets.”<sup>21</sup> In short, the two reports support the idea that policies and incentives are the main drivers for renewable energy market growth, which in turn spurs renewable energy job growth.

*“RPS policies continue to play a central role in supporting RE growth.”*  
- NREL

Given this information, Navigant created a scoring system to assess wind and solar strategies by state and determine whether there was a correlation between these strategies and the number of solar and wind jobs per state. The solar scoring accounted for RPS, NEM, Solar Renewable Energy Credits (SRECs), third party PPAs, the number of financial incentives available as well as non-policy market factors, such as electric rates and solar resource availability. The wind scoring included RPS, the number of financial incentives, electric rates, and wind resource availability. Table 3-2 shows the scoring framework for all policies and incentives assessed.

<sup>20</sup> Lawrence Berkeley National Laboratory (LBNL), US Renewables Portfolio Standards: 2017 Annual Status Report Abstract, <https://emp.lbl.gov/publications/us-renewables-portfolio-standards-0>.

<sup>21</sup> National Renewable Energy Laboratory (NREL), “Are Incentives the Thing?”, December 2014, <https://www.nrel.gov/docs/fy15osti/63059.pdf>.

**Table 3-2. State Strategy Scoring Framework**

Categories	Scoring
RPS*	RPS Standards – 4 RPS Goals – 2 No RPS – 0
Net Metering**	Net Metering – 2 Other Rules – 1 No Net Metering – 0
SRECs**	SRECs – 2 SRECs Eligible – 1 No SRECs – 0
Third Party PPAs	Third party PPAs – 1 No Third party PPAs – 0 Status Unclear – 0
Financial Incentives	Many state incentives – 2 Some state incentives – 1 Few state incentives – 0
Electric Rates*	High Rates – 4 Medium Rates – 2 Low Rates – 0
Wind & Solar* Resources	High Resource – 4 Medium Resource – 2 Little Resource – 0

Source: Navigant 2017

\*Navigant applied extra weight to these categories given influence on wind or solar developments.

\*\* Only used in solar scoring framework

Navigant chose to add additional weights to RPS, electric rates, and wind and solar resource availability due to their significant influence on renewable energy development. For example, ample sunshine or wind resources reduce business risk while high electric rates improve the financials of developing these resources. Figure 3-2 shows the scoring calculations to assess state strategies for both wind and solar.

**Figure 3-2. State Strategy Scoring Calculations**

**Solar Strategy Score** = RPS + Net Metering + SRECs + Third Party PPAs + Financial Incentives + Electric Rates + Solar Resources

**Wind Strategy Score** = RPS + Financial Incentives + Electric Rates + Wind Resources

### 3.3.1 Solar

The calculations resulted in a ranking of states according to their strategy score. To determine the success of these strategies, Navigant compared the rankings to the number of solar jobs in each state.<sup>22</sup> The table below shows the 10 states with the most jobs per capita and their associated Navigant strategy rank.

**Table 3-3. Top 10 Solar Job States vs. Navigant Strategy Rank**

Top 10 Solar Job States <sup>23</sup>	State	State Solar Jobs per Capita <sup>24</sup>	Navigant Strategy Framework State Rank <sup>25</sup>
1	California	100,050	1
2	Massachusetts	14,582	5
3	Texas	9,396	15
4	Nevada	8,371	13
5	Florida	8,260	28
6	New York	8,135	15
7	Arizona	7,310	5
8	North Carolina	7,112	5
9	New Jersey	6,056	4
10	Colorado	6,004	3

See footnotes for sources.

As shown above, nine of the top ten solar jobs states land within the top fifteen of Navigant's ranking. The only exception is Florida, which has a particularly strong solar resource and therefore, high number of jobs, despite having fewer policies and financial incentives than its peers. This reinforces the idea that policies and incentives drive market and job growth in the solar industry. In Figure 3-3, Navigant plotted the rankings against the number of jobs per capita per state for the entire country to demonstrate the correlation.

*State-level and national policies drive a large portion of business model decisions, particularly related to the location of regional offices and manufacturing. - First Solar*

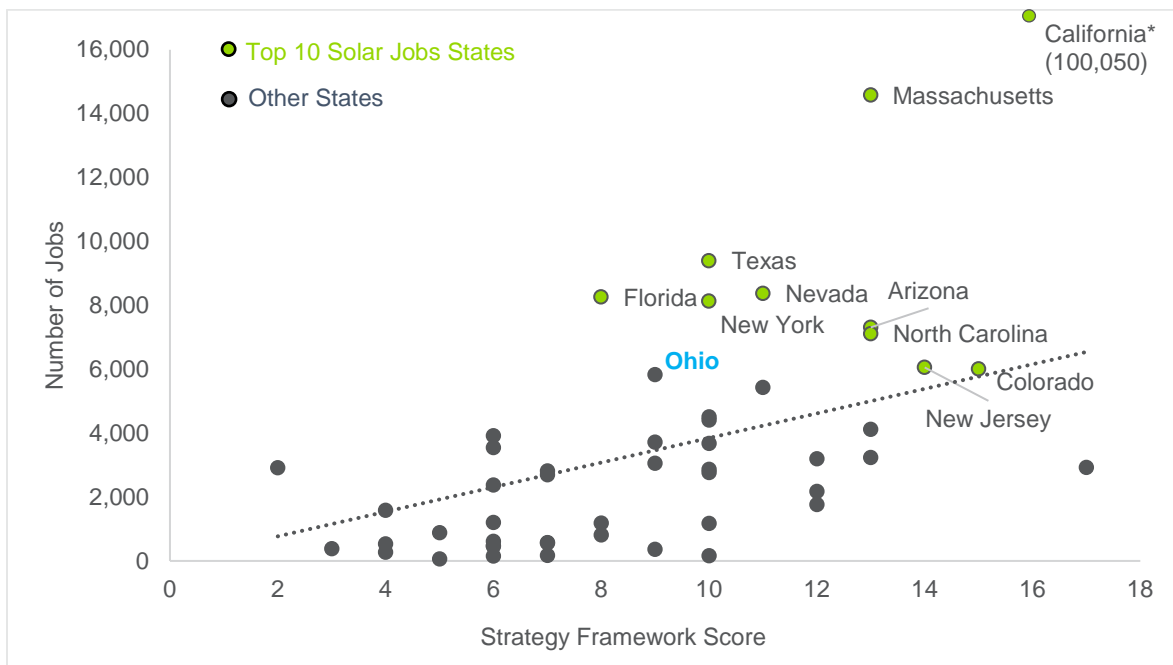
<sup>22</sup> Navigant extracted state jobs data from The Solar Foundation, The 2016 Solar Job Census, <https://www.thesolarfoundation.org/national/>.

<sup>23</sup> Ibid.

<sup>24</sup> Ibid.

<sup>25</sup> Navigant analysis.

**Figure 3-3. Solar Jobs per Capita vs. Solar Strategies**



Source: Navigant 2017

\*Navigant removed California from the scatter plot and added separately due to the magnitude of jobs in California.

The plot shows that strong policies and incentives, high electric rates, and a robust solar resource correlates with a high number of solar jobs.

### 3.3.2 Wind

Similar to the solar analysis, Navigant compared the wind strategy score against the number of wind jobs per state. The table below shows the results of this comparison.

**Table 3-4. Top 10 Wind Job States vs. Navigant Strategy Rank**

Top 10 Wind Job States <sup>26</sup>	State	State Wind Jobs <sup>27</sup>	Navigant Strategy Framework State Rank <sup>28</sup>
1	Colorado	4,144	15
2	Texas	2,979	15
3	Iowa	1,929	15
4	Ohio	1,626	11
5	Illinois	1,482	15

<sup>26</sup> American Wind Energy Association, Economic Development Impact of Wind Projects prepared by Navigant.

<sup>27</sup> Ibid.

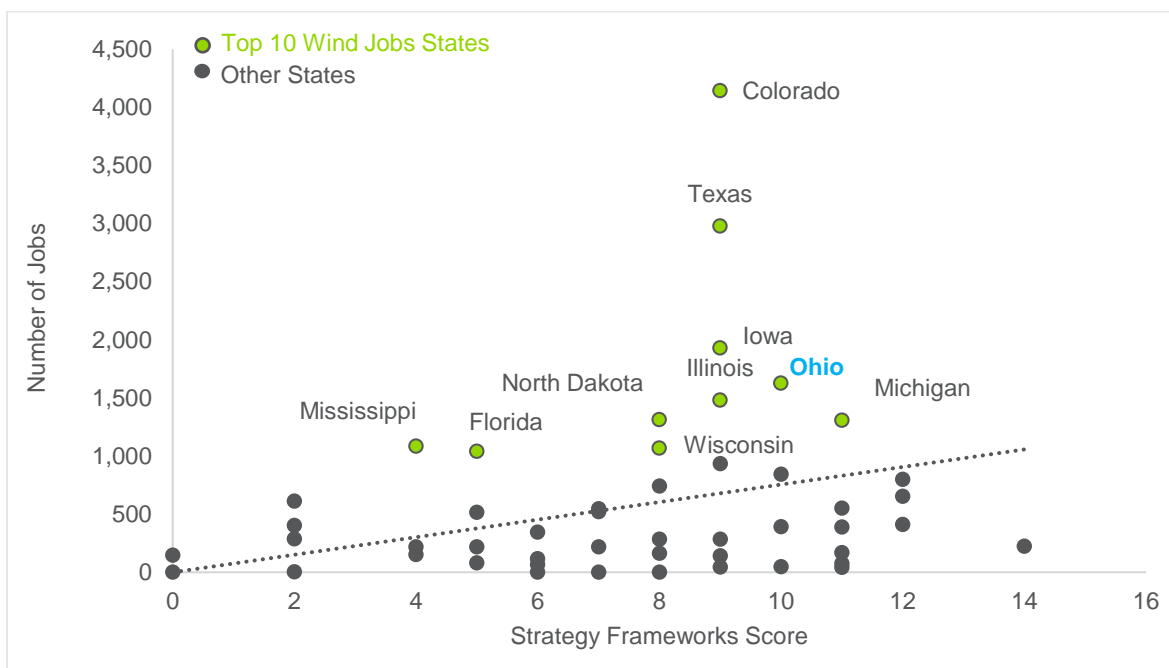
<sup>28</sup> Navigant analysis.

6	North Dakota	1,313	23
7	Michigan	1,308	5
8	Mississippi	1,086	42
9	Wisconsin	1,068	23
10	Florida	1,041	38

See footnotes for sources.

Most of the top wind job states rank within the top fifteen on Navigant's strategy framework scale. The other states including North Dakota, Mississippi, Wisconsin, and Florida fall within the twenty-three to forty-two rank. Other factors, such as proximity to key transportation routes (Mississippi), significant wind resources (North Dakota and Wisconsin), and low state taxes (Florida) contribute to the high number of wind manufacturing jobs in states that do not have strong wind-related policies or incentives. In Figure 3-4, Navigant plotted the rankings against the number of jobs per capita per state to demonstrate the pattern.

**Figure 3-4. Wind Jobs per Capita vs. Wind Strategies**



Source: Navigant 2017

The plot above shows that only a loose correlation exists between strategies implemented and number of jobs. The correlation is likely not as strong, due to a variety of factors. One of these factors stems from the fact that a large portion of wind jobs are in manufacturing, jobs that are less

driven by policy and incentives.<sup>29</sup> Instead they are driven by logistics, workforce preparedness, and supply chain, as outlined in Section 2.3 and Table 2-2.

## 3.4 KEY TAKEAWAYS

By identifying and quantifying the success of state strategies, Navigant further understood the levers and how they may affect the regional market. From this analysis, the team verified that

*When asked how the state could aid the industry, all case study participants noted the need for stable and supportive policies and incentives.*

policies, such as RPS, Net Metering, third-party PPAs, and financial incentives, in addition to solar resource availability and high electric rates, play a large role in driving solar jobs at the state level. Meanwhile policies and financial incentives play a less significant role in the growth of wind jobs, due in large part to the types of wind jobs available. This means that crafting strategies and recommendations to target the wind and solar industry will need to account for these differing factors.

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<sup>29</sup> According to AWEA, there were 21,000 jobs in wind manufacturing and 38,000 jobs in operations and development in 2016, meaning 35% of jobs are in manufacturing. Source: AWEA, US Wind Power Jobs Hit Record, Up 20 Percent in 2016, <https://www.awea.org/MediaCenter/pressrelease.aspx?ItemNumber=8736>.

## 4. OHIO ASSESSMENT

After analyzing factors that may influence renewable energy market and job growth, Navigant assessed the current state of jobs and companies in Ohio, aimed at establishing a baseline for the renewable energy companies in Ohio.

### 4.1 APPROACH

The approach for the assessment consisted of outlining the value chain for the wind and solar industries, conducting research on companies currently in Ohio, charting companies to the value chain and plotting them on the map of Ohio.

To outline the value chains for wind and solar, the team leveraged Navigant's expertise and assessed the number of companies that fit into each portion of the value chain. This required gathering data on wind and solar companies by state from industry trade associations, including the Solar Energy Industry Association (SEIA)<sup>30</sup> and the American Wind Energy Association (AWEA).<sup>31</sup> Navigant also conducted additional research to find companies that may not have been covered by SEIA or AWEA's databases. Using the information gathered, Navigant compared the value chain to the companies in Ohio to determine if Ohio had any elements missing.

### 4.2 OHIO RENEWABLE ENERGY COMPANIES & MANUFACTURERS

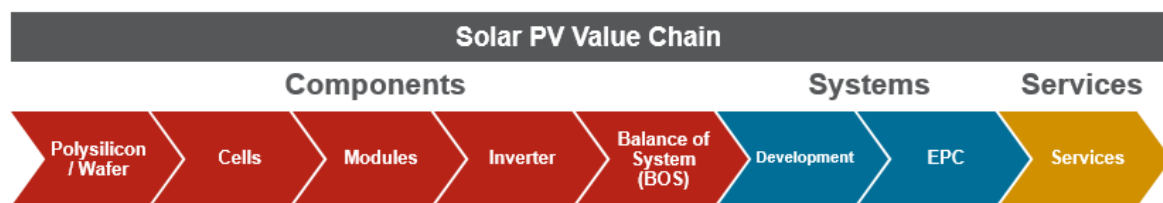
The approach yielded value chains for the solar and wind sectors and a map of the geographic distribution of companies in Ohio. The sections below describe these results.

#### 4.2.1 Solar Companies & Manufacturers

*"Potential to leverage local glass manufacturing and institutional research provided critical local ecosystems" – First Solar*

The solar value chain consists of manufactured components, system development processes, and downstream services. The manufactured components begin with raw materials, such as water and polysilicon, which companies then transform into cells and modules for the solar panels. The remaining components include the inverters and balance of systems (BOS), which incorporate wiring, switches and racking. Systems is the next element of the value chain, which includes the development of solar site as well as the Engineering, Procurement, and Construction (EPC) of the system. These processes involve acquiring land or a location for the project, obtaining the necessary permits, procuring an end-user or off-taker, and building the system. Once constructed, the system will require additional services including operations and maintenance, financing, etc. Figure 4-1 details the Solar PV Value Chain.

Figure 4-1. Solar PV Value Chain



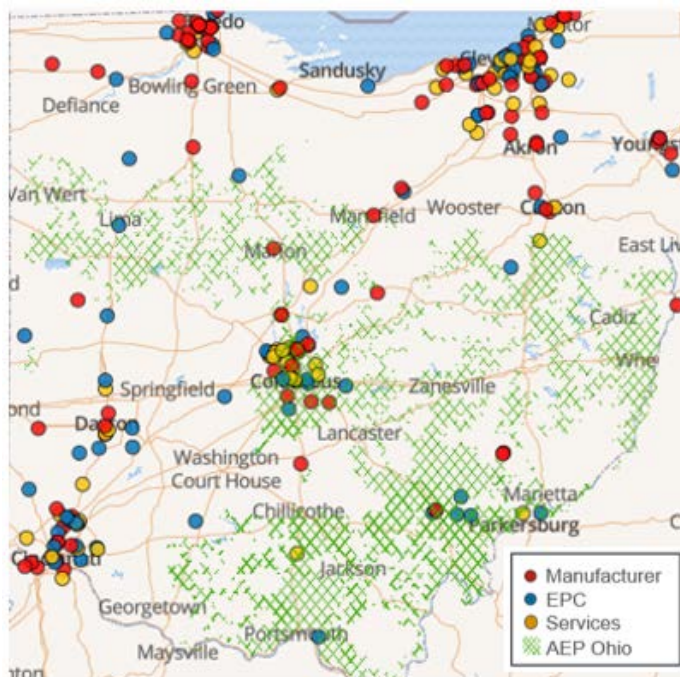
Source: Navigant 2017

<sup>30</sup> SEIA, National Solar Database.

<sup>31</sup> AWEA, Wind Farm & Manufacturer Map.

Navigant used SEIA's National Solar database to identify solar companies in Ohio. SEIA's database also consists of a map, showing the geographic distribution of companies by type. Navigant overlaid a layer with AEP Ohio's service territory on top of this map to determine if the companies fell within their service area. Figure 4-2 shows the map.

**Figure 4-2. Map of Solar PV Companies in Ohio**



Source: SEIA, National Solar Database; Navigant, AEP Ohio Solar Territory Overlay

The map shows that Ohio has a variety of solar-focused companies across the state. These companies tend to be clustered within major cities, such as Toledo, Cleveland, Columbus, and Cincinnati. Clustering within cities is common for most markets. This often occurs due to the solar market potential (a larger population equates to more customers) as well as the ease of access to major transportation routes and skilled labor. Companies spotlighted in the case studies cited these factors as major influencers in the company's locational decisions. Appendix A provides the case study key takeaways.

## 4.2.2 Wind Companies & Manufacturers

The wind value chain consists of manufacturing components, system development, and downstream services. The manufacturing components include three separate parts: the blades, the tower, and the nacelle, which includes the train, generator, and other electrical components. Next, the system development portion of the value chain involves the system assembly and EPC, including acquiring a system location, designing a system, procuring equipment, finding an off-taker, obtaining the necessary permits, and constructing the wind project. The turbines require routine upkeep and other maintenance activities, which downstream service companies support. Figure 4-3 details the wind value chain.



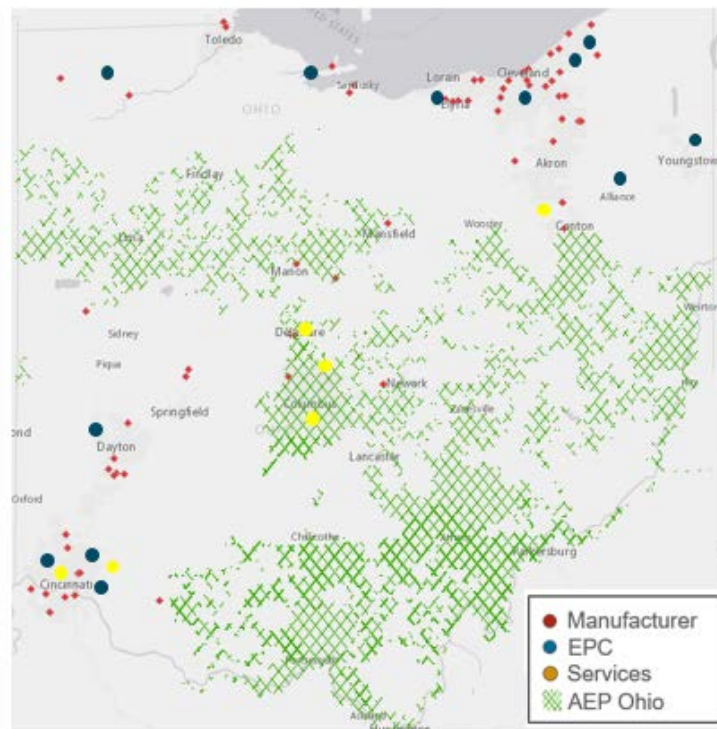
Figure 4-3. Wind Value Chain



\*Nacelle includes train, generator, and other electrical components  
Source: Navigant 2017

Navigant gathered information regarding the wind companies currently in Ohio, using AWEA's Manufacturing Company database and conducting additional research. Navigant added the non-manufacturing wind companies to the map as well as AEP Ohio's service territory. Figure 4-4 shows the map.

Figure 4-4. Map of Wind Companies in Ohio and AEP Ohio Service Territory



Source: AWEA Wind Farm & Manufacturer Map; Navigant, AEP Ohio Service Territory Overlay; Green Energy Ohio, Renewable Energy Installers in Ohio

The map above illustrates that Ohio has wind manufacturers and developers sprinkled throughout the state. According to AWEA's database of wind manufacturers and wind farms, Ohio has more wind manufacturers than any other state.<sup>32</sup> The companies tend to be clustered in the following major cities: Cleveland, Dayton, and Cincinnati. Companies also exist in smaller numbers near Columbus and Toledo. The clusters around Cleveland, Cincinnati, and Dayton, may be due to existing manufacturing automotive manufacturing near Great Lakes cities, like Cleveland and access to major waterway transport routes. The latter is especially important for wind

<sup>32</sup> AWEA, Wind Farm & Manufacturer Map Database, <https://www.awea.org/AWEAWindFarmandFactoryMap>.

manufacturers and developers given the size and weight of the turbines. For example, Cincinnati sits near the Ohio River and at the junction of Interstates-71, 74, and 75, major transportation routes. Likewise, Toledo is located on Lake Erie and near Interstates-75 and 80.

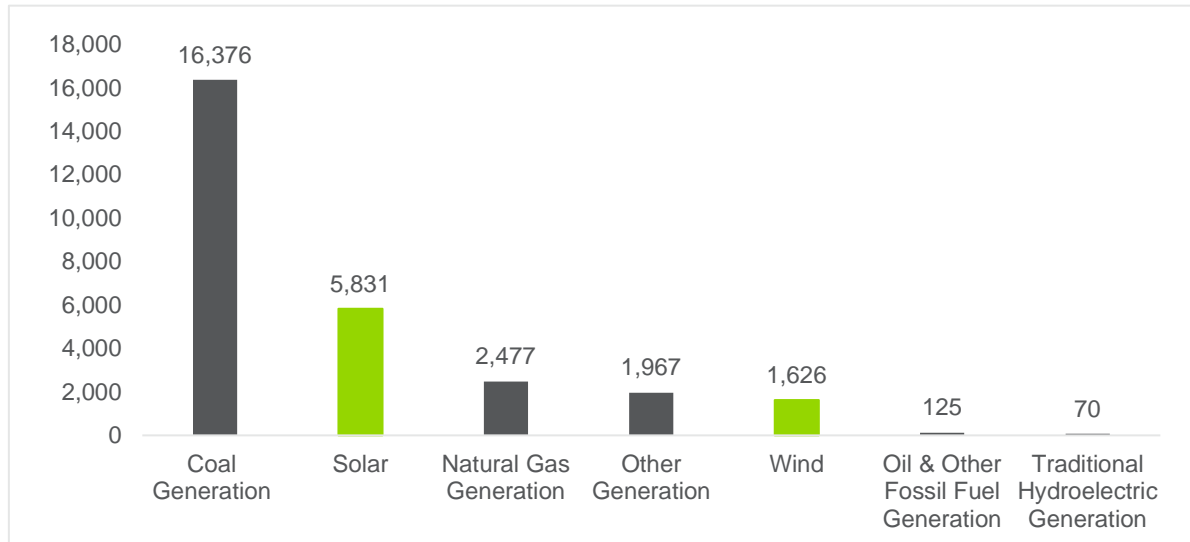
### 4.3 KEY TAKEAWAYS

Based on this assessment, Navigant concluded that Ohio currently has a thriving renewable energy market with a variety of different types of wind and solar companies. This market has likely resulted from Ohio's proximity to a strong Central and Midwest wind market and a strong solar market driven by policy and incentives in the state of Ohio and the Northeast. As the demand for renewable energy continues to grow, Ohio needs to continue to encourage companies to locate within the state.

## 5. CAREER TRANSITION

Navigant examined strategies to facilitate employee transition to renewable energy opportunities as they arise. According to a 2017 report from the US Department of Energy (DOE), traditional fossil fuel generation, specifically coal, makes up the largest electric power job segment in Ohio. Solar generation follows in second place and wind in fifth place, behind natural gas and other generation. Figure 5-1 shows the electric power job segments and their respective number of jobs.

**Figure 5-1. Ohio Electric Power Generation Employment by Sub Technology**



Source: *The Solar Job Census 2016*, The Solar Foundation, <https://solarstates.org/#state/ohio/counties/solar-jobs/2016>; *Economic Development Impact of Wind Projects*, Navigant report prepared for AWEA; *US Energy and Employment Report*, January 2017

As Ohio moves away from conventional power plants, existing workers will need to transition into other industries. The graphic above illustrates this point, showing the magnitude of the number of workers that may need assistance in this transition. Given their skillset and knowledge, it naturally makes sense that these workers may transition into other energy industry careers, especially in growing markets, such as wind and solar. This highlights the importance of developing pathways for these workers and assisting in the transition process. The goal of this portion of the study is to outline these pathways, identify resources to aid in the transition, and determine strategies to continue supporting this effort.

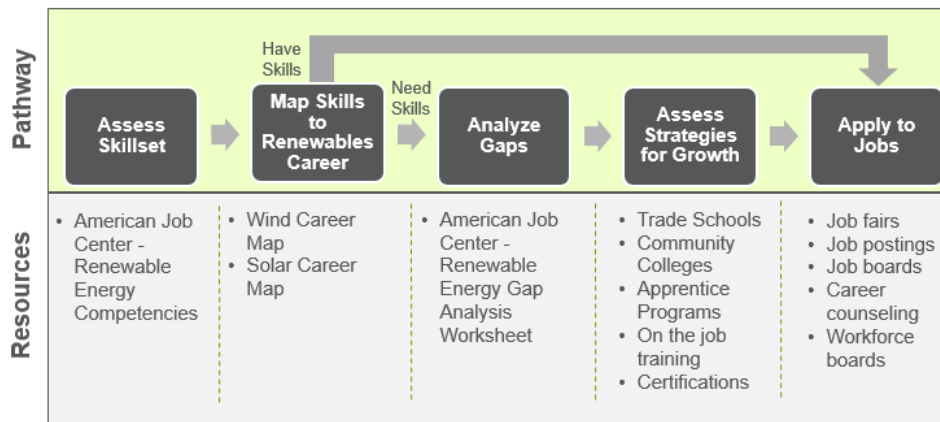
### 5.1 APPROACH

Navigant conducted secondary research on current programs and resources available from trade associations and federal, state, and local initiatives for facilitating transitions to the renewable energy industry. The team developed a pathway of steps for prospective employees to follow, outlining key resources for each step. Next, Navigant identified the roles key stakeholders, including states, utilities, individuals, and solar and wind companies may play throughout the process.

### 5.2 CAREER PATHWAY TRANSITION

Navigant developed a conventional power plant to renewable energy career transition pathway. Figure 5-2 gives an overview of that pathway, which consists of five steps: assess skillset, map skills to renewables career, analyze gaps, assess strategies for growth, and apply to jobs.

Figure 5-2. Career Transition Pathway



Resource links will be provided throughout the section as well as in Appendix B.  
Source: Navigant 2017

- **Assess skillset** – Includes inventorying skills acquired from past jobs. This process will give the transitioning employee an idea of his or her current abilities.
- **Map skills to renewables career** – There are several readily available tools for conducting the mapping, including the Interstate Renewable Energy Council's (IREC) Solar Career Map<sup>33</sup> and the DOE's Wind Career Map.<sup>34</sup> The American Job Center also provides competency models and worksheets related to renewable energy careers.<sup>35</sup> All the tools listed have interactive interfaces for users to explore job details, advancement pathways, lateral pathways, transition success factors, and additional resources.
- **Analyze Gaps** – Once a prospective employee understands his or her skills and the skills necessary for a career in renewables, he or she will need to analyze the gaps between the two. The American Job Center includes a "gap analysis worksheet" and an "identify credential competencies worksheet" to aid in this process.<sup>36</sup>
- **Assess Strategies for Growth** – The pathway user will need to assess opportunities for filling these gaps. Ideas for obtaining skills include attending community college courses, enrolling in an apprentice program, obtaining certifications, and seeking on-the-job training opportunities. The Solar Foundation's Solar Training Network provides an overview of these opportunities by state for those looking for careers in solar.<sup>37</sup>
- **Apply to Jobs** – Once the prospective employee has the necessary skills and knowledge, he or she can begin applying to jobs by leveraging job fairs, job postings, and job boards.

*"Only 34% of employer respondents indicated that they provide formal on-the-job training."*  
- The Solar Foundation 2017

<sup>33</sup> Interstate Renewable Energy Council (IREC), Solar Career Map, [irecsolarcareermap.org](http://irecsolarcareermap.org)

<sup>34</sup> DOE Office of Energy Efficiency & Renewable Energy, Wind Career Map, <https://energy.gov/eere/wind/wind-career-map>.

<sup>35</sup> American Job Center Competency Model Clearinghouse, Energy: Renewable Energy Competency Model, <https://www.careeronestop.org/competencymodel/competency-models/renewable-energy.aspx>.

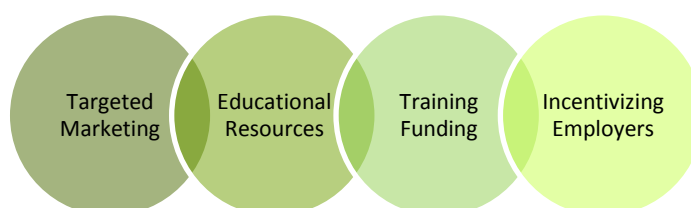
<sup>36</sup> American Job Center Competency Model Clearinghouse, Energy: Renewable Energy Competency Model – Download Model, <https://www.careeronestop.org/competencymodel/competency-models/pyramid-download.aspx?industry=renewable-energy>.

<sup>37</sup> The Solar Foundation, Solar Training Network, <http://www.solartrainingusa.org/>.

## 5.3 STRATEGIES FOR FACILITATING PATHWAY

As shown in Figure 5-3, Navigant identified four strategies that stakeholders can enact: conducting targeted marketing, providing educational resources to workers, funding training programs for workers, and incentivizing employers to create or host training programs. The strategies are intended to work in conjunction, helping conventional power plant workers transition.

**Figure 5-3. Strategies for Facilitating Career Transition Pathway**



- **Targeted marketing** uses strategic advertising channels to increase awareness about training and job opportunities. Often, employees do not know what resources are available and this strategy aims to bridge that gap by helping connect employees to resources. Specific targeted marketing ideas include offering specialized workshops and job fairs, creating user-friendly job boards, and building communication channels to ensure prospective workers can find relevant information.
- **Educational resources** involve developing informational pieces and coordinating educational opportunities. Examples of resources include: pamphlets, fliers, websites, workshops, and other materials. The Solar Training Network lists six solar trainers and workforce boards throughout the state of Ohio. If these trainers and boards are not located near a transitioning employee, it may be difficult to fill skills or knowledge gaps. Providing additional educational resources helps mitigate this issue.
- **Training funding** is important because if a transitioning worker does not have the adequate funding to attend a needed training course, it may be difficult to secure a job within the industry. By providing funding for training programs through scholarships, educational vouchers, grants, or subsidized training, employees stand a better chance of participating. This is especially important as conventional power plant jobs decline.
- **Incentivizing employers** to provide educational resources and training funding to transitioning workers by making industry knowledge and skills more accessible. Navigant's research revealed that employers often understand the need for solar training but do not provide training themselves.<sup>38</sup> The research also mentioned that employers often do not take advantage of incentive opportunities, such as federal funding, due to a lack of knowledge.<sup>39</sup> Therefore, providing more incentives and marketing to employers can aid in changing this culture.

*"79% of employers stated that there's a need for solar training."*  
-The Solar Foundation 2017

<sup>38</sup> The Solar Foundation, Solar Training and Hiring Insights, 2017, <http://www.solartrainingusa.org/wp-content/uploads/2016/10/Solar-Training-and-Hiring-Insights-2017-1.pdf>.

<sup>39</sup> Ibid.

## 6. FINDINGS AND RECOMMENDATIONS

After completing the analysis, Navigant revisited each individual task to synthesize the findings and provide action-oriented recommendations. This final task involved reviewing key sources, conducting an internal working sessions with key stakeholders, and analyzing programs for renewable energy in Ohio. These activities resulted in high-level guidelines for creating programs and detailed recommendations for Ohio. This section provides the details of these guidelines and recommendations.

### 6.1 FINDINGS

Upon reviewing the takeaways from each individual analysis, revisiting key sources, and reviewing the case study transcripts, Navigant created four guiding principles for implementing strategies. By applying these principles to their programs, stakeholders can ensure sustainable renewable energy company and job growth. Table 6-1 describes each of the four principles which guide Navigant's recommendations in Section 6.2.

*"When they put the freeze on it (SB 310), [investors] said it was too risky to invest in Ohio."* – Dovetail Solar & Wind

**Table 6-1. Guiding Principles for Implementing Renewable Energy-Related Programs**

Guiding Principle	Description
Market Stability 	Renewable energy market growth depends on long-term policies. These policies reduce market risk for stakeholders and ensure a stable long-term market.
Consistent Programs 	Like market stability, companies regularly leverage and rely on state and utility programs (e.g. incentives) to expand operations. Short-term programs will only produce short-term jobs and company expansion; therefore, programs must be consistent in the long-term.
Workforce Preparation 	As the industry grows, market players will need an educated workforce to meet demand. For this reason, workforce preparation should be a focus of renewable energy policies and programs.
Research & Development 	Continuous research and development (R&D) will prepare the renewable energy industry in Ohio for change and enhance its market "competitiveness."

### 6.2 RECOMMENDATIONS

Based on the analyses and guiding principles, Navigant created five recommendations to drive renewable energy company establishment and job growth. More specifically, the implementation of

these recommendations will aid in creating a stable market, reducing barriers for prospective market entrants, and providing resources for companies and transitioning workers.

Since policies and programs can drive renewable energy market growth, Navigant identified several recommendations that target these areas. Table 6-2 below lists the recommendations identified.

**Table 6-2. Recommendations**

No.	Recommendation
1	Publish multi-year state renewable energy procurement plan, led by the state or a state-wide body
2	Expand JobsOhio to include: <ul style="list-style-type: none"> <li>Renewable energy education platform providing career transition resources</li> <li>Concierge service to answer renewable energy related questions</li> </ul>
3	Remove permitting barriers
4	Invest in Research & Development
5	Continue to invest in roads and infrastructure

These suggestions align to the broader findings in Section 6.1.

**1. Recommendation: Publish multi-year state renewable energy procurement plan.**

**Importance:** A multi-year renewable energy procurement plan helps companies understand the opportunity in Ohio by advertising Ohio's commitment to procuring renewable energy. This commitment helps interested parties understand the long-term market need for renewables, reducing business risk. The publication may spur additional local market entrants, who want to bid into procurement opportunities and signals that Ohio is supportive of renewable energy development.

**Next Steps:** The state or a state-wide body should aggregate the plans and publish them in a central location for the public and more importantly, renewable energy companies to view. Trade associations and other communication channels should advertise the plans directly to renewable energy companies. The publication should include details about how companies can participate in the procurement process and where to go for more information.

**2. Recommendation: Expand JobsOhio to include renewable energy as an eligible industry. Include education tools and concierge services for prospective companies and workers.**

**Importance:** By expanding JobsOhio to include renewable energy as a targeted industry, the Ohio market can leverage valuable resources and incentives to spur growth. Companies will have access to long-term funding for research and development and operating expense reduction in addition to site selection resources. This centralized website shows the state's commitment to encouraging further renewable energy company and job growth. By expanding the program's services to incorporate concierge services, which provide information regarding the state's renewable energy procurement plans, rate structures, and incentives, will reduce barriers to entering the Ohio renewable energy market. Finally, creating a component of the website that targets workers looking to transition into the renewable energy market can aid in connecting valuable labor resources to prospective companies, while also providing



educational information to transitioning workers. Once more this improves the ease of doing business in Ohio and prepares the workforce for the growing demand in jobs. These suggestions align closely to the analysis findings in Section 3, which conclude that incentives, in conjunction with policies, contribute to localized renewable energy growth.

**Next Steps:** The implementation of this recommendation requires expanding the eligibility of the JobsOhio program to include the renewable energy industry. Since the state of Ohio runs the program, the government should set a directive for the incorporation of this industry to spur further growth. Program administrators should also collaborate with utility companies and the PUCO to further expand its concierge services to provide guidance to renewable energy developers, investors, companies and workers looking to transition to the industry.

### 3. Recommendation: Remove permitting barriers

**Importance:** This recommendation addresses the findings from Section 2, in which Navigant defined and prioritized company motivators. The analysis concluded that the number one driver of industry growth for general renewable energy companies is the Renewable Energy Market, which includes supportive permitting policies. By establishing permitting policies that reduce barriers, the state and local jurisdictions can reduce development costs and time for developers. Key industry stakeholders, including the DOE and NREL, have programs specifically aimed at streamlining permitting processes to encourage renewable energy growth, illustrating the importance of permitting. The DOE's SolSmart program incentivizes local governments to improve permitting processes by awarding special designations to cities that remove permitting obstacles. Cities must create a permit checklist, review current processes, and write a memo describing the existing barriers in zoning and permitting to receive the designation.<sup>40</sup> These actions align to the program goals, which include improving business prospects for solar developers and saving governments time and money.<sup>41</sup> Likewise, a recent study by NREL examined renewable energy permitting in Hawaii and concluded that improved processes for permitting, such as providing checklists and creating permitting application templates, would reduce project delays and improve the feasibility of projects.<sup>42</sup> These initiatives and studies underscore the significance of permitting in renewable energy development.

**Next Steps:** The state of Ohio as well as local jurisdictions should examine permitting processes to identify barriers, like the NREL report on Hawaii or the SolSmart initiative requirements. The study should focus on understanding how certain requirements affect companies in terms of timing, costs, and overall project feasibility. After identifying barriers, the state should implement targeted actions to improve the process. Actions may include creating a permitting checklist and guidelines, establishing application templates, reducing required paperwork, eliminating stringent permitting requirements, and instating mechanisms for expediting the permitting process.

### 4. Recommendation: Invest in Research & Development

**Importance:** Investing in research and development will help prepare the state for industry changes and improve its overall competitiveness. This principle and recommendation stems from the findings in Section 2, which included the lists of company locational drivers. Navigant identified research and development as a key supportive scheme that encourages companies

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<sup>40</sup> SolSmart, Program Guide,

[https://static1.squarespace.com/static/56035ff7e4b01dadee1991a1/t/571feca54d088efedb7f66d6/1461709994244/SolSmart\\_ProgramGuide\\_web.pdf](https://static1.squarespace.com/static/56035ff7e4b01dadee1991a1/t/571feca54d088efedb7f66d6/1461709994244/SolSmart_ProgramGuide_web.pdf)

<sup>41</sup> SolSmart, "Why Participate?", <http://www.gosparc.org/home-2>

<sup>42</sup> NREL, "Renewable Energy Permitting Barriers in Hawaii: Experience from the Field", March 2013, <https://www.nrel.gov/docs/fy13osti/55630.pdf>.



to locate in specific destinations and the case studies verified this recommendation. First Solar noted that it decided to locate its manufacturing facilities in Perrysburg, Ohio because R&D facilities and schemes already existed in the area.<sup>43</sup> First Solar also mentioned that this pattern exists in many other states, including California, New York, and Tennessee.<sup>44</sup> Other studies, such as the Deloitte Competitiveness Index, also rank R&D as a significant factor for manufacturing competitiveness. The firsthand accounts along with significant market research emphasize the importance of research and development in encouraging company establishment.

**Next Steps:** The state should stimulate the growth of renewable energy R&D by providing funding opportunities through loans, grants, and other incentives. The government should also look to leverage resources from local colleges and universities by advertising incentives directly to these entities, establishing targeted research programs dedicated to renewable energy, and helping connect universities and renewable energy firms.<sup>45</sup>

## 5. Recommendation: Continue to invest in roads and infrastructure

**Importance:** Since renewable energy development requires the transport of large equipment (e.g., turbines and panels), companies and in particular manufacturers locate near major transportation routes, corroborated by the findings of this study. The maps depicting the location of renewable energy companies in Ohio illustrate that companies not only tend to cluster around major cities but also near major transportation routes. A large portion of wind companies are located near Lake Erie, which allows for the transportation of turbines across the Atlantic to the Northeast and to states across the Great Lakes. Additionally, most of the case study participants stated access to transportation as one of their top three locational motivators, providing a firsthand account of its significance.

**Next Steps:** Ohio should continue funding its roads and transportation infrastructure. The state may also consider expanding transportation routes to cities with the potential for a robust renewable energy industry. This may require an in-depth geographic analysis of potential sites for transportation and infrastructure expansion.

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<sup>43</sup> Interview with First Solar, September 19, 2017.

<sup>44</sup> Ibid.

<sup>45</sup> Stark State College and The Timken Company provide an example of a public-private partnership between a local university and renewable energy company. The two partnered to create the Stark State College and the Timken Company Technology and Test Center, which focuses on creating wind turbine technology. More information can be found on Stark State College's website: <https://www.starkstate.edu/news/timken-stark-state-open-technology-test-center/>.

## APPENDIX A. CASE STUDY KEY TAKEAWAYS

Navigant conducted four case study interviews with renewable energy companies in Ohio. The companies include both wind and solar companies, one manufacturer, and renewable energy developers focused on different end-user segments. The table below provides information about these companies, including business type and renewable energy industry.

**Table A-1. Case Study Participants**

Company	Solar	Wind	AEP Territory	Ohio Business Type
SunEnergy1	✓		✓	Utility-scale solar developer. Projects in AEP Ohio Territory.
Dovetail Solar & Wind	✓	✓	✓	Residential, commercial, & utility-scale renewable energy developer.
Energy Optimizers USA	✓			Design and installation of solar PV and solar thermal systems for K-12 schools as well as energy efficiency services.
First Solar	✓			Manufacturing for corporate, community, & utility-scale solar developments.

Several key themes regarding locational drivers and recommendations emerged from the case studies. In terms of locational drivers, case study participants felt the following factors were the most influential: a stable and predictable market for renewables; skilled talent; and logistics. As for recommendations, the companies agreed that the state and local utilities should continue to provide renewable energy incentives and enact consistent policies.

The remaining portion of this appendix provides the key takeaways from the case study interviews.

## SUNENERGY1

### Company Background:

SunEnergy1 engineers, procures, constructs and operates utility-scale ground and roof-mounted solar projects. To-date, SunEnergy1 has constructed over 500MWs of solar and holds over 2,500 MWs of solar projects in its pipeline. The firm has projects located throughout the eastern United States.

### Locational Drivers:

- **Utility's Needs [for renewables]:** SunEnergy1 stated that the utility's needs influenced its project and operational locations in North Carolina.
- **Community Interest:** Similar to the Utility's needs, the company considered project locations based on the community's desire for solar.
- **County Involvement:** Counties may play a similar role to states and communities, providing incentives and driving the market through the permitting process.

### Recommendations:

- Incentivize solar further. SunEnergy1 noted that state incentives played a direct role in locating its operations in North Carolina.
- Select proven and well-vetted solar companies when procuring energy for a new project.

### Company Summary

**Company Type:** Development, Engineering, Procurement, Construction, and Operations for Solar

**HQ Location:** Mooresville, NC

**Other Locations:** Bethel, NC; Projects in OH, WV, VA, SC, and MD.

**No. of Employees:** 500, 1-5 in OH

### Top 3 Locational Drivers:

1. Utility's Needs
2. Community Interest
3. County Involvement

## DOVETAIL SOLAR & WIND

### Company Background:

Dovetail Solar & Wind primarily focuses on developing commercial and utility scale solar PV. Originally located in Athens, OH, Dovetail moved its headquarters to Cleveland to gain access to more customers and better talent. Today, the company continues to grow its operations and looks towards states and cities with supportive renewable energy policies for additional facilities.

### Locational Drivers:

- **Robust market for renewables:** Without a market for its product, a business cannot exist. Dovetail began in Athens and has since moved to urban areas with a larger population and market to build the business.
- **Access to talent:** Building renewables requires a certain skillset. Having access to a larger pool of talent, such as being close to a university, increases access.
- **Access to transportation corridors:** Ease of access and flow of materials makes it easier to conduct business.

### Recommendations:

- Help create a climate of stability for investors, businesses, and the overall market through consistent and supportive policy.
- Continue to work with the Public Utilities Commission to create consistent policies as well as ensuring that smaller companies have a role to play in the growing renewables market.

### Company Summary

**Company Type:** Solar & Wind Developer

**HQ Location:** Cleveland, OH

**Other Locations:** Columbus, Athens, & Cincinnati, OH; Brighton, MI

**No. of Employees:** 26

### Top 3 Locational Drivers:

1. Utility's Needs
2. Community Interest
3. County Involvement

## ENERGY OPTIMIZERS, USA

### Company Background:

Energy Optimizers, USA provides comprehensive energy efficiency and renewable energy services. On the renewable energy side, Energy Optimizers designs and installs solar PV and solar thermal systems, primarily for K-12 schools.

### Locational Drivers:

- **State Policy:** Energy Optimizers, USA decided to locate in Ohio due to its well-established energy performance contracting legislation for education and governmental institutions. The company also cited the Alternative Energy Portfolio Standard (AEPS) passed in 2009 as a reason for locating in Ohio.
- **Strong Renewables Market:** Due to its specific market, the company sited local schools as a reason for locating in Ohio. Schools provide a strong training network to leverage.
- **Proximity to Transportation:** The firm wanted to be located within a fifteen-mile radius of the I-70 and I-75 highways to serve their customers.

### Recommendations:

- Promote and support renewable energy and energy efficiency programs. Additionally, incentive programs make the state more attractive.
- Provide a positive and supportive perspective of grid-tied renewable energy systems and rebate programs for energy efficiency.

### Company Summary

**Company Type:** Design and Construct Solar PV & Solar Thermal

**HQ Location:** Tipp City, OH

**Other Locations:** NA

**No. of Employees:** 22

### Top 3 Locational Drivers:

1. State Policy
2. Strong Market
3. Proximity to Transportation

## FIRST SOLAR

### Company Background:

First Solar engages in solar module manufacturing, research and development, and technology innovation as well as project development, financing, and operations and maintenance for the utility-scale solar projects.

### Locational Drivers:

- **Supply Chain Ecosystem:** Surrounding market for R&D and technology innovation as well as high availability of quality materials played a large role in First Solar's decision to locate its manufacturing in Perrysburg.
- **Access to Markets:** Since First Solar is a major international solar PV module manufacturer, the company relies on access to markets through transportation, such as domestic trucking routes.
- **Skilled Labor Force:** A strong manufacturing labor force skilled in working with glass and electronics supported First Solar's decision to locate its manufacturing in Perrysburg.

### Recommendations:

- Create certainty through state-level policy. It is important for maintaining a sustainable solar PV manufacturing facility.
- Collaborate with key stakeholders to support existing local infrastructure and manufacturing through sustained renewable energy policies.

### Company Summary

**Company Type:** R&D, Manufacturing, Development, Financing, and O&M for Solar PV

**HQ Location:** Tempe, AZ

**Other Locations:** Perrysburg, OH; Houston, TX; Bridgewater, NJ; San Francisco, CA; Mexico, Malaysia

**No. of Employees:** 5,400; 760 in OH

### Top 3 Locational Drivers:

4. Utility's Needs
5. Community Interest
6. County Involvement

## APPENDIX B. CAREER TRANSITION RESOURCES

While laying out pathways for existing conventional power plant workers to move into the renewable energy industry, Navigant conducted a thorough review of available resources. Appendix B lists those resources with the goal of providing these resources for prospective renewable energy workers. Section 5 of the report offers more details about the career transition pathway.

**Table B-1. Career Transition Resources for Prospective Workers**

Resource Name, Author, & Link	Description	Resource Type
American Job Center, Energy: Renewable Energy Competency Model and Worksheets <a href="https://www.careeronestop.org/competencymodel/competency-models/renewable-energy.aspx">https://www.careeronestop.org/competencymodel/competency-models/renewable-energy.aspx</a>	Model and associated worksheets that describe the skills and competencies necessary to work in renewable energy jobs. Worksheets include a gap analysis and credential competencies identification.	Wind & Solar Worksheets
Interstate Renewable Energy Council (IREC), Solar Career Map <a href="http://irecsolarcareermap.org/">http://irecsolarcareermap.org/</a>	Tool that allows users to identify and explore different career paths within the Solar Industry.	Solar Career Exploration
Department of Energy, Office of EERE, Wind Career Map <a href="https://energy.gov/eere/wind/wind-career-map">https://energy.gov/eere/wind/wind-career-map</a>	Tool that allows users to identify and explore different career paths within the Wind Industry.	Wind Career Exploration
The Solar Foundation, Solar Training & Hiring Insights 2017, Available Tools and Resources for the Solar Industry, By Category <a href="http://www.solartrainingusa.org/research/">http://www.solartrainingusa.org/research/</a>	Comprehensive survey of trends in solar training and hiring, including resources for prospective workers	Solar Career Tools & Training Resources
Department of Energy, Office of EERE, Wind Career Map Resource List <a href="https://energy.gov/eere/wind/wind-career-map-resource-list">https://energy.gov/eere/wind/wind-career-map-resource-list</a>	List of resources used to develop the Wind Career Map. Resources include a variety of career and training information for prospective employees.	Wind Career Tools & Training Resources

**This foregoing document was electronically filed with the Public Utilities**

**Commission of Ohio Docketing Information System on**

**12/13/2017 2:46:04 PM**

**in**

**Case No(s). 17-0882-EL-UNC**

Summary: Report - Ohio Renewable Energy Manufacturing & Company Establishment  
Analysis electronically filed by Mr. Steven T Nourse on behalf of Ohio Power Company