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| | | | |
|---|---|---|---|
| 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

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driven by policy and incentives.[29] 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 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.

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

[29] 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.

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# 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)[30] and the American Wind Energy Association (AWEA).[31] 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

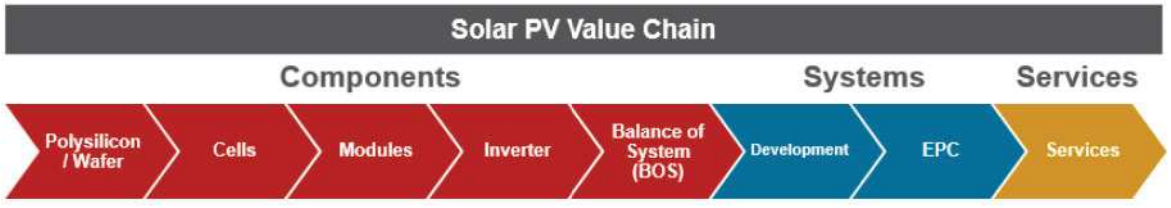
The approach yielded value chains for the solar and wind sectors and a map of the geographic distribution of companies in Ohio. The sections below describe these results.

### 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*

[30] SEIA, National Solar Database.
[31] AWEA, Wind Farm & Manufacturer Map.

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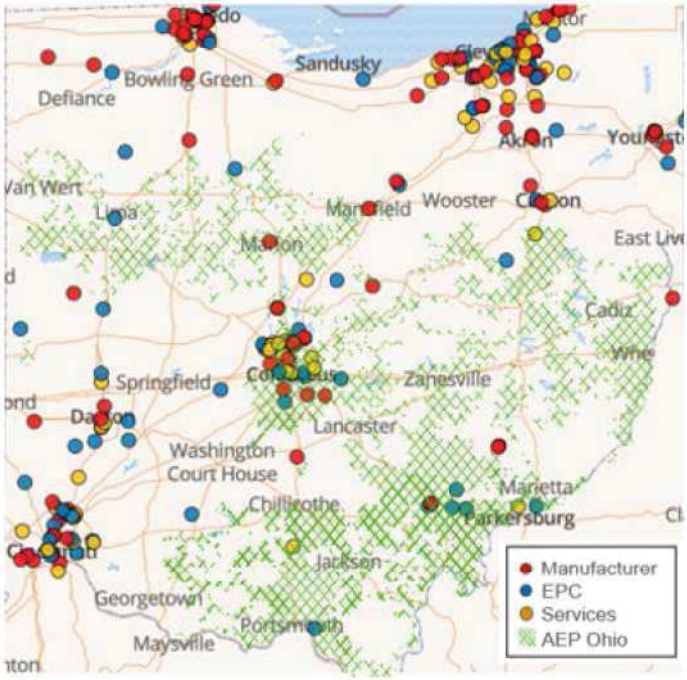
Navigant used SEIA's National Solar database to identify solar companies in Ohio. SEIA's database also consists of a map, showing the geographic distribution of companies by type. Navigant overlaid a layer with AEP Ohio's service territory on top of this map to determine if the companies fell within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

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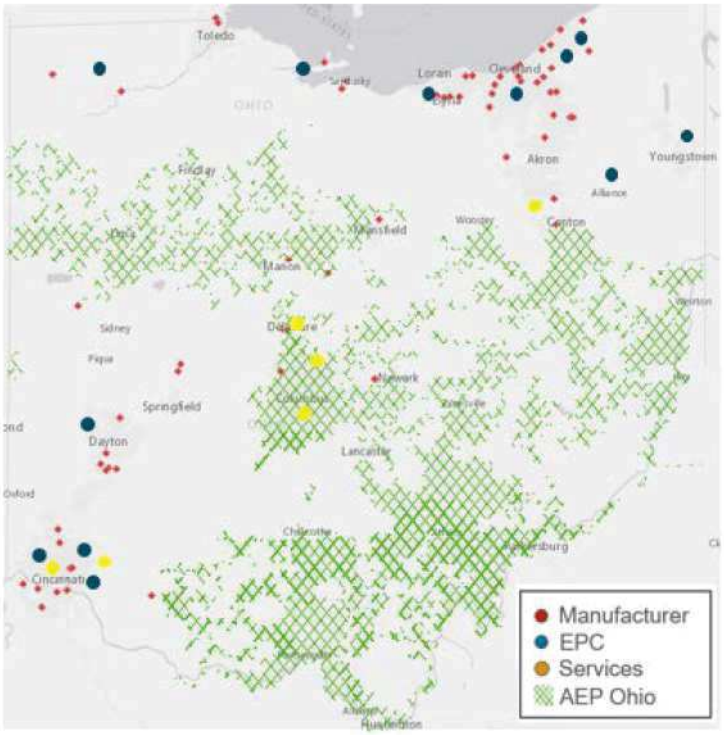
**Figure 4-3. Wind Value Chain**


*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.[32] 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

[32] AWEA, Wind Farm & Manufacturer Map Database, https://www.awea.org/AWEAWindFarmandFactoryMap.

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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.

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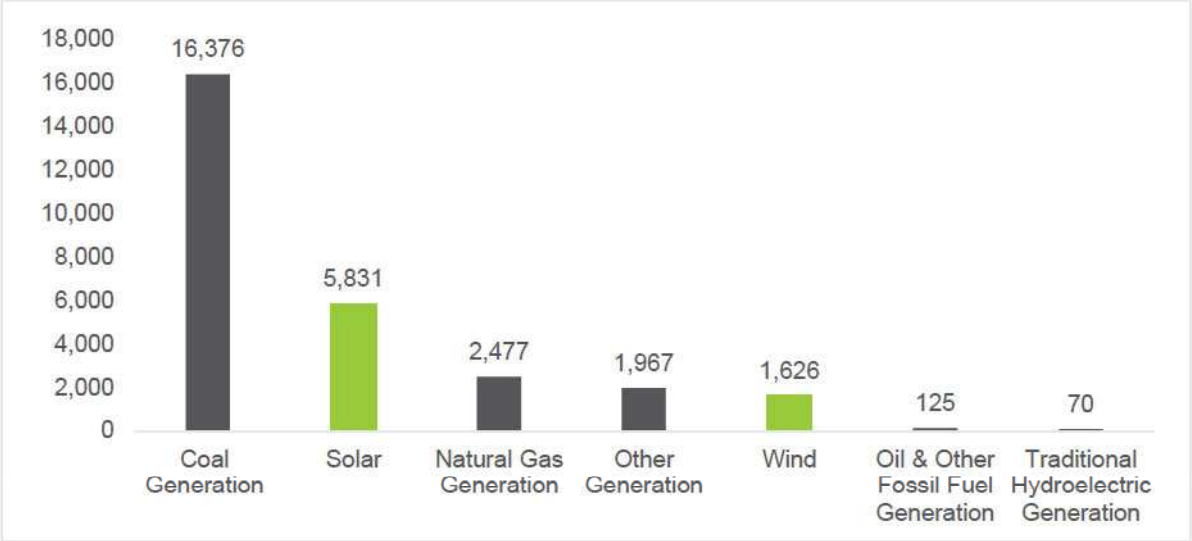
# 5. CAREER TRANSITION

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.

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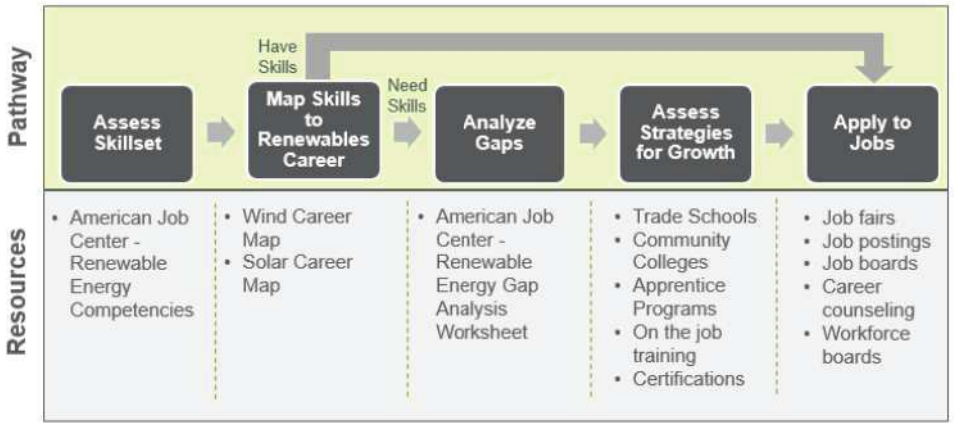
**Figure 5-2. Career Transition Pathway**




*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[33] and the DOE's Wind Career Map.[34] The American Job Center also provides competency models and worksheets related to renewable energy careers.[35] 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.[36]
- **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.[37]

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

- **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.

[33] Interstate Renewable Energy Council (IREC), Solar Career Map, irecsolarcareermap.org
[34] DOE Office of Energy Efficiency & Renewable Energy, Wind Career Map, https://energy.gov/eere/wind/wind-career-map.
[35] American Job Center Competency Model Clearinghouse, Energy: Renewable Energy Competency Model, https://www.careeronestop.org/competencymodel/competency-models/renewable-energy.aspx.
[36] 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.
[37] The Solar Foundation, Solar Training Network, http://www.solartrainingusa.org/.

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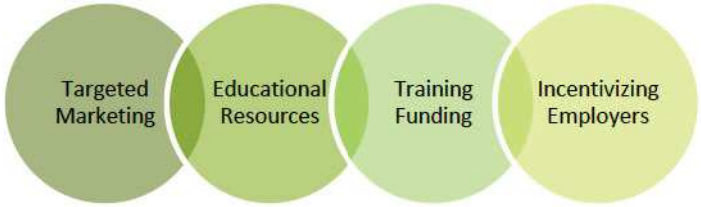
## 5.3 STRATEGIES FOR FACILITATING PATHWAY

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.

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

- **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.[38] The research also mentioned that employers often do not take advantage of incentive opportunities, such as federal funding, due to a lack of knowledge.[39] Therefore, providing more incentives and marketing to employers can aid in changing this culture.

[38] 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.
[39] Ibid.

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# 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

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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:<br>• Renewable energy education platform providing career transition resources<br>• Concierge service to answer renewable energy related questions |
| 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

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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.[40] These actions align to the program goals, which include improving business prospects for solar developers and saving governments time and money.[41] 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.[42] 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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[40] SolSmart, Program Guide, https://static1.squarespace.com/static/56035ff7e4b01dadee1991a1/t/571feca54d088efedb7f66d6/1461709994244/SolSmart_ProgramGuide_web.pdf

[41] SolSmart, "Why Participate?", http://www.gosparc.org/home-2

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

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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.[43] First Solar also mentioned that this pattern exists in many other states, including California, New York, and Tennessee.[44] 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.[45]

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.

[43] Interview with First Solar, September 19, 2017.
[44] Ibid.
[45] 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.

**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

**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.

## 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.

| 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 |

**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.

## 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.

| 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 |

**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.

# 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 https://www.careeronestop.org/competencymodel/competency-models/renewable-energy.aspx | 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 http://irecsolarcareermap.org/ | 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 https://energy.gov/eere/wind/wind-career-map | 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 http://www.solartrainingusa.org/research/ | 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 https://energy.gov/eere/wind/wind-career-map-resource-list | 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 |

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

**PJM Generation Queue**
**Ohio Solar PV Projects**

| Queue Number | Name | Commercial Name | State | County | Status | Transmission Owner | MFO | MW Energy | MW Capacity | Fuel |
|---|---|---|---|---|---|---|---|---|---|---|
| AB1-014 | Hillcrest 138kV | Hillcrest Solar Facility | Ohio | Brown | Engineering and Procurement | DEOK | 125 | 125 | 47.5 | Solar |
| AB2-083 | Delano 138kV | | Ohio | Ross | Active | AEP | 40 | 40 | 27.2 | Solar |
| AB2-085 | Adams 138kV | | Ohio | Adams | Active | AEP | 80 | 80 | 54.4 | Solar |
| AB2-131 | Galion-Roberts South 138kV | | Ohio | Marion | Active | ATSI | 150 | 150 | 57 | Solar |
| AB2-170 | East Lima-Marysville 345kV | | Ohio | Hardin | Active | AEP | 130 | 130 | 49.4 | Solar |
| AC1-001 | Delano 138kV | | Ohio | Ross | Active | AEP | 80 | 80 | 54.4 | Solar |
| AC1-068 | Atlanta 69kV I | | Ohio | Pickaway | Active | Dayton | 49.9 | 49.9 | 34 | Solar |
| AC1-069 | Atlanta 69kV II | | Ohio | Pickaway | Active | Dayton | 49.9 | 49.9 | 34 | Solar |
| AC1-078 | Beatty-London 138kV | | Ohio | Madison | Active | ATSI | 176 | 176 | 66 | Solar |
| AC1-082 | Ravenswood-Hemlock 69kV | | Ohio | Meigs | Active | AEP | 48 | 48 | 29 | Solar |
| AC1-085 | Stuart-Clinton 345kV | | Ohio | Highland | Active | Dayton | 400 | 400 | 152 | Solar |
| AC1-089 | Hillsboro-Wildcat 138kV | | Ohio | Highland | Active | AEP | 150 | 150 | 57 | Solar |
| AC1-165 | Atlanta 69kV III | | Ohio | Pickaway | Active | Dayton | 49.9 | 49.9 | 33.6 | Solar |
| AC1-166 | Atlanta 69kV IV | | Ohio | Pickaway | Active | Dayton | 49.9 | 49.9 | 33.6 | Solar |
| AC1-167 | Mark Center 69kV | | Ohio | Defiance | Active | AEP | 49.9 | 49.9 | 33.6 | Solar |
| AC1-188 | Rio-Lick 138kV | | Ohio | Jackson | Active | AEP | 70 | 70 | 46.6 | Solar |
| AC1-194 | Elk 138kV | | Ohio | Vinton | Active | AEP | 125 | 125 | 47.5 | Solar |
| AC2-015 | Chatfield-Howard 138kV | | Ohio | Crawford | Active | AEP | 117 | 117 | 53.55 | Solar |
| AC2-029 | Circleville 138kV | | Ohio | Pickaway | Active | AEP | 70 | 70 | 26.6 | Solar |
| AC2-035 | Lick-Firebrick 69kV | | Ohio | Jackson | Active | AEP | 49 | 49 | 29.4 | Solar |
| AC2-036 | Ravenswood-East Bashan Switch 69kV | | Ohio | Meigs | Active | AEP | 0 | 20 | 12 | Solar |
| AC2-038 | Lee 69kV | | Ohio | Athens | Active | AEP | 20 | 20 | 12 | Solar |
| AC2-044 | Maddox Creek 345kV | | Ohio | Van Wert | Active | AEP | 20 | 20 | 7.6 | Solar |
| AC2-048 | Sporn 138kV | | Ohio | Meigs | Active | AEP | 60 | 60 | 22.8 | Solar |
| AC2-055 | Buckskin-Petersburg 69kV | | Ohio | Highland | Active | AEP | 47.5 | 47.5 | 18.05 | Solar |
| AC2-059 | Biers Run-Circleville 138kV | | Ohio | Ross | Active | AEP | 127 | 127 | 62.5 | Solar |
| AC2-060 | Buckskin 69kV | | Ohio | Ross | Active | AEP | 100 | 100 | 64 | Solar |
| AC2-061 | Hillsboro-Clinton 138kV | | Ohio | Ross | Active | AEP | 117 | 117 | 58.1 | Solar |
| AC2-064 | Hillsboro-Millbrook 138kV | | Ohio | Highland | Active | AEP | 115 | 115 | 69 | Solar |
| AC2-066 | Hillcrest 138kV | Hillcrest Solar Facility | Ohio | Brown | Engineering and Procurement | DEOK | 200 | 75 | 28.5 | Solar |
| AC2-067 | Camden-Crystal I 69kV | | Ohio | Preble | Active | Dayton | 49.9 | 49.9 | 18.9 | Solar |
| AC2-068 | Camden-Crystal II 69kV | | Ohio | Preble | Active | Dayton | 20 | 20 | 7.6 | Solar |
| AC2-087 | Buckskin 69kV | | Ohio | Ross | Active | AEP | 85 | 85 | 47.4 | Solar |
| AC2-088 | S. Bethel-Brown 69kV | | Ohio | Brown | Active | DEOK | 70 | 70 | 38.4 | Solar |
| AC2-111 | College Corner 138kV | | Ohio | Preble | Active | AEP | 80 | 80 | 30.4 | Solar |
| AC2-124 | Gunn Road 345kV | | Ohio | Hardin | Active | AEP | 50 | 50 | 19 | Solar |
| AC2-195 | Galion-Roberts South 138kV | | Ohio | Marion | Active | ATSI | 100 | 99.96 | 62.1 | Solar |
| AD1-015 | Frazeysburg 138 kV | | Ohio | Muskingum | Active | AEP | 150 | 150 | 57 | Solar |
| AD1-072 | Biers Run-Circleville 138 kV | | Ohio | Ross | Active | AEP | 20 | 20 | 13.7 | Solar |
| AD1-073 | Buckskin 69 kV | | Ohio | Ross | Active | AEP | 120 | 20 | 13.2 | Solar |
| AD1-081 | Beatty-London 138 kV | | Ohio | Madison | Active | ATSI | 196 | 20 | 13.2 | Solar |
| AD1-101 | Continental 69 kV | | Ohio | Putnam | Active | AEP | 49.9 | 49.9 | 18.96 | Solar |
| AD1-106 | North Waldo-Wild Creek 138 kV | | Ohio | Marion | Active | AEP | 60 | 60 | 22.8 | Solar |
| AD1-119 | Payne 69 kV | | Ohio | Paulding | Active | AEP | 49.9 | 49.9 | 18.96 | Solar |
| AD1-130 | Hardin Switch 345 kV | | Ohio | Hardin | Active | AEP | 170 | 170 | 115 | Solar |
| AD1-136 | South Bethel-Brown 69 kV | | Ohio | Clermont | Active | DEOK | 80 | 10 | 5.4 | Solar |
| AD1-140 | Greene-Clark 138 kV | | Ohio | Greene | Active | ATSI | 175 | 175 | 95.8 | Solar |
| AD1-141 | S. Lucasville-Wakefield 138 kV | | Ohio | Scioto | Active | AEP | 50 | 50 | 30 | Solar |

**PJM Generation Queue**
**Ohio Solar PV Projects**

| Queue Number | Name | Commercial Name | State | County | Status | Transmission Owner | MFO | MW Energy | MW Capacity | Fuel |
|---|---|---|---|---|---|---|---|---|---|---|
| AD2-010 | Hillsboro 138 kV | | Ohio | Highland | Active | AEP | 200 | 200 | 120 | Solar |
| AD2-011 | Hillsboro 138 kV | | Ohio | Highland | Active | AEP | 100 | 100 | 60 | Solar |
| AD2-012 | Hillsboro 138 kV | | Ohio | Highland | Active | AEP | 49 | 49 | 29.4 | Solar |
| AD2-014 | Steubenville-Tidd 138 kV | | Ohio | Jefferson | Active | AEP | 53.3 | 53.325 | 22.4 | Solar |
| AD2-016 | Biers Run-Circleville 138 kV | | Ohio | Ross | Active | AEP | 274 | 127 | 62.5 | Solar |
| AD2-031 | Martinsville-Wilmington 69 kV | | Ohio | Clinton | Active | Dayton | 50 | 50 | 19 | Solar |
| AD2-067 | Centerburg 138kV | | Ohio | Licking | Active | AEP | 150 | 150 | 57 | Solar |
| AD2-086 | Marysville-East Lima 345kV | | Ohio | Hardin | Active | AEP | 230 | 230 | 138 | Solar |
| AD2-092 | Marysville 345kV | | Ohio | Union | Active | AEP | 175 | 175 | 105 | Solar |
| AD2-093 | Marysville 345kV | | Ohio | Union | Active | AEP | 225 | 225 | 135 | Solar |
| AD2-147 | South Charleston 345kV | | Ohio | Butler | Active | Dayton | 100 | 100 | 42 | Solar |
| AD2-151 | Hillcrest 345kV | | Ohio | Muskingum | Active | DEOK | 100 | 100 | 42 | Solar |
| AD2-162 | Biers Run-Circleville 138kV | | Ohio | Pickaway | Active | AEP | 110 | 110 | 73.81 | Solar |
| AD2-163 | East Springfield-Mill Creek 138kV | | Ohio | Madison | Active | ATSI | 180 | 180 | 120.7 | Solar |
| AE1-007 | Camden-Crystal III 69kV | | Ohio | Preble | Active | Dayton | 89.9 | 20 | 7.6 | Solar |
| AE1-008 | College Corner 138kV | | Ohio | Preble | Active | AEP | 100 | 20 | 7.6 | Solar |
| AE1-040 | Greenfield 69 kV | | Ohio | Fayette | Active | Dayton | 47.5 | 47.5 | 31.6 | Solar |
| AE1-090 | Hardin Switch 345 kV | | Ohio | Hardin | Active | AEP | 50 | 50 | 21.56 | Solar |
| AE1-091 | West Newton-Lynn 138 kV | | Ohio | Hardin | Active | AEP | 110 | 110 | 46.93 | Solar |
| AE1-092 | Blue Jacket-Kirby 138 kV | | Ohio | Union | Active | Dayton | 229.5 | 229.5 | 96.4 | Solar |
| AE1-102 | Maddox Creek 345 kV | | Ohio | Van Wert | Active | AEP | 26 | 26 | 15.6 | Solar |
| AE1-120 | Hillcrest 138 kV | | Ohio | Brown | Active | DEOK | 200 | 0 | 44 | Solar |
| AE1-146 | Ebersole #2-Fostoria Central 138 kV | | Ohio | Hancock | Active | AEP | 120 | 120 | 81.8 | Solar |
| AE1-227 | South Cumberland 69kV | | Ohio | Guernsey | Active | AEP | 49.5 | 49.5 | 49.5 | Solar |
| | **TOTALS** | | | | | | **7,460** | **6,512** | **3,378** | |

**PJM Generation Queue**
**Wind Energy Projects - Ohio**

| Queue Number | Name | Commercial Name | State | County | Status | Transmission Owner | MFO | MW Energy | MW Capacity | MW In Service | Fuel |
|---|---|---|---|---|---|---|---|---|---|---|---|
| R52A | Kings Creek 69kV | Buckeye Wind Farm - Phase 2 | Ohio | Champaign | Engineering and Procurement | Dayton | 100 | 100 | 20 | | Wind |
| T131 | Lincoln-Sterling 138kV | Paulding Wind Farm III LLC | Ohio | Paulding | Partially in Service - Under Construction | AEP | 150 | 150 | 30 | 100.8 | Wind |
| U2-072 | East Lima-Marysville 345kV | Scioto Ridge Wind Farm | Ohio | Hardin | Engineering and Procurement | AEP | 300 | 300 | 39 | | Wind |
| U4-001 | Howard 138kV | Black Fork Wind | Ohio | Richland | Engineering and Procurement | AEP | 200 | 200 | 26 | | Wind |
| U4-028 | Fostoria Central-Greenlawn-Howard 138kV | Seneca Wind | Ohio | Seneca | Engineering and Procurement | AEP | 100 | 100 | 13 | | Wind |
| U4-029 | Fostoria Central-Greenlawn-Howard 138kV | Seneca Wind | Ohio | Seneca | Engineering and Procurement | AEP | 200 | 100 | 13 | | Wind |
| Z1-035 | Lake Erie Wind 138kV | | Ohio | Unknown | Active | ATSI | 18 | 18 | 2.34 | | Offshore Wind |
| AC1-051 | Willard-S. Greenwich 69kV | | Ohio | Huron | Active | AEP | 60 | 60 | 7.8 | | Wind |
| AC1-173 | Logtown 138kV | | Ohio | Paulding | Active | AEP | 75.9 | 75.9 | 9.9 | | Wind |
| AC1-176 | Timber Switch 138kV | | Ohio | Paulding | Active | AEP | 58.7 | 58.7 | 7.6 | | Wind |
| AC2-103 | Davis Besse-Beaver 345kV | | Ohio | Erie | Active | ATSI | 297.7 | 297.66 | 38.69 | | Wind |
| AC2-104 | Marysville-Sorenson 765kv | | Ohio | Van Wert | Active | AEP | 500.3 | 500.25 | 65 03 | | Wind |
| AD1-070 | Fostoria Central 138 kV | | Ohio | Hancock | Active | AEP | 205 | 205 | 36 | | Wind |
| AD1-103 | Davis Besse-Beaver 345 kV | | Ohio | Huron | Active | ATSI | 500.4 | 500.4 | 65.052 | | Wind |
| AD1-104 | Marysville-Sorenson 765 kV II | | Ohio | Van Wert | Active | AEP | 403.2 | 403.2 | 52.42 | | Wind |
| AD2-087 | Randolf 138kV | | Ohio | Darke | Active | AEP | 200 | 200 | 35.2 | | Wind |
| AD2-136 | Melmore Tap 138kV | | Ohio | Seneca | Active | AEP | 360 | 360 | 46.8 | | Wind |
| AD2-138 | Olive-Reynolds 345kV | | Ohio | Muskingum | Active | AEP | 200 | 200 | 35.2 | | Wind |
| AD2-191 | Melmore 138kV | | Ohio | Seneca | Active | AEP | 400 | 200 | 200 | | Wind |
| AE1-245 | Haviland 138kV | | Ohio | Paulding | Active | AEP | 150 | 150 | 19.5 | | Wind |
| | **TOTALS** | | | | | | **4,479** | **4,179** | **763** | | |

Exhibit JAL-16

CONFIDENTIAL

Intentionally Omitted

**OHIO POWER COMPANY'S RESPONSE TO
INTERSTATE GAS SUPPLY'S
DISCOVERY REQUEST
PUCO CASE NO. 18-501-EL-FOR, 18-1392-EL-RDR, AND 18-1393-EL-ATA
FOURTH SET**

**INTERROGATORY**

IGS-INT-04.9 Regarding the Navigant Study, at TH-1, P 15 of 41, it is stated that Navigant worked with AEP to randomly select 120,000 residential customers to participate in the survey. Regarding this statement:
a. Identify what steps were taken to randomly select 120,000 customers.
b. Identify whether the sample included customers of all ages and genders
c. Identify whether AEP has an e-mail address for all customers.
d. Identify whether the absence of an e-mail address excluded a customer's ability to participate.
e. Identify whether the survey included customers from all areas of AEP's service territory.
f. Identify whether the survey included customers taking service from a competitive retail electric service provider.
g. Identify the percent of customers that responded that receive competitive retail electric service from AEP under the standard service offer.

**RESPONSE**

a. Navigant requested that AEP Ohio randomly select 120,000 customers and that random selection was performed by AEP Ohio.
b. The pool of customers who were sampled and invited to take the survey were randomly selected from AEP Ohio customers with email addresses. Navigant does not know the specific individuals or accounts who responded to the survey. The demographic questions at the end of the appendix included a question for age range (Question 14) but there was no question to identify gender.
c. AEP Ohio does not have email addresses for all customers.
d. The absence of an e-mail address excluded a customer's ability to participate.
e. The pool of customers who were sampled and invited to take the survey were randomly selected from AEP Ohio customers with email addresses. Navigant does not know the specific individuals or accounts who responded to the survey or their location.
f. Navigant cannot confirm which customers received or took the survey. It is possible that customers taking service from a competitive retail electric service provider took the survey as such customers were not excluded from the survey.
g. This is unknown. Navigant does not know the specific individuals or accounts who responded to the survey and the survey did not include a question to determine whether a respondent is taking service from a competitive retail provider.

Prepared by: Trina Horner

**OHIO POWER COMPANY'S RESPONSE TO**
**INTERSTATE GAS SUPPLY'S**
**DISCOVERY REQUEST**
**PUCO CASE NO. 18-501-EL-FOR, 18-1392-EL-RDR, AND 18-1393-EL-ATA**
**FOURTH SET**

## INTERROGATORY

IGS-INT-04.8 Regarding the Navigant Study, at TH-1, P 14 of 41, it is stated that "this outreach should not be considered statistically representative of AEP's C&I customer base or even its largest corporate customer base due to the targeted sample selection approach and relatively limited number of responses." Regarding this statement:
a. What is meant by the "targeted sample selection approach."
b. How was the sample selection approach developed.

## RESPONSE

a. Targeted sample selection approach means that the sample selected was not random.
b. Navigant used AEP Ohio customer data and its own research to identify a group of large C&I customers comprised of the top 100 load customers, customers associated with one of the four sustainability organizations identified elsewhere in Exhibit TH-1, and customers known to AEP Ohio to have installed on-site distributed generation. Navigant distributed the questionnaire to the subset of that group for whom AEP Ohio provided email addresses. Navigant distributed 124 email invitations to participate in the Questionnaire.

Prepared by: Trina Horner

Summary: Testimony Direct Testimony of Jonathan A. Lesser, Ph.D on Behalf of the Office of the Ohio Consumers Counsel - Public Version - Part 3 of 3 electronically filed by Ms. Deb J. Bingham on behalf of Willis, Maureen R Mrs.