

## Final Technical Report from Oberlin College

<b>1. DOE Award Number and Award Recipient:</b>	DE-OE0000483 Oberlin College
<b>2. Project Title and Project Director Name:</b>	Energy Transmission and Infrastructure Northern Ohio 4.10 Jane Mathison
<b>3. Date of Report and Reporting Period:</b>	March 22, 2013 October 1, 2010 – December 31, 2012

### 4. Executive Summary (minimum of 1 paragraph)

The objective of *Energy Transmission and Infrastructure Northern Ohio (OH)* was to lay the conceptual and analytical foundation for an energy economy in northern Ohio that will:

- improve the efficiency with which energy is used in the residential, commercial, industrial, agricultural, and transportation sectors for Oberlin, Ohio as a district-wide model for Congressional District OH-09;
- identify the potential to deploy wind and solar technologies and the most effective configuration for the regional energy system (i.e., the ratio of distributed or centralized power generation);
- analyze the potential within the district to utilize farm wastes to produce biofuels;
- enhance long-term energy security by identifying ways to deploy local resources and building Ohio-based enterprises;
- identify the policy, regulatory, and financial barriers impeding development of a new energy system; and
- improve energy infrastructure within Congressional District OH-09.

This objective of laying the foundation for a renewable energy system in Ohio was achieved through **four primary areas of activity**:

1. district-wide energy infrastructure assessments and alternative-energy transmission studies;
2. energy infrastructure improvement projects undertaken by American Municipal Power (AMP) affiliates in the northern Ohio communities of Elmore, Oak Harbor, and Wellington;
3. Oberlin, OH-area energy assessment initiatives; and
4. a district-wide conference held in September 2011 to disseminate year-one findings.

The grant supported 17 research studies by leading energy, policy, and financial specialists, including studies on: current energy use in the district and the Oberlin area; regional potential for energy generation from renewable sources such as solar power, wind, and farm-waste; energy and transportation strategies for transitioning the City of Oberlin entirely to renewable resources and considering pedestrians, bicyclists, and public transportation as well as drivers in developing transportation policies; energy audits and efficiency studies for Oberlin-area businesses and Oberlin College; identification of barriers to residential energy efficiency and development of programming to remove these barriers; mapping of the solar-photovoltaic and wind-energy supply chains in northwest Ohio; and opportunities for vehicle sharing and collaboration among the ten organizations in Lorain County from the private, government, non-profit, and educational sectors. With non-grant funds, organizations have begun or completed projects that drew on the findings of the studies, including: creation of a residential energy-efficiency program for the Oberlin community; installation of energy-efficient lighting in Oberlin College facilities;

and development by the City of Oberlin and Oberlin College of a 2.27 megawatt solar photovoltaic facility that is expected to produce 3,000 megawatt-hours of renewable energy annually, 12% of the College's yearly power needs. Implementation of these and other projects is evidence of the economic feasibility and technical effectiveness of grant-supported studies, and additional projects are expected to advance to implementation in the coming years. The public has benefited through improved energy-delivery systems and reduced energy use for street lighting in Elmore, Oak Harbor, and Wellington; new opportunities for assistance and incentives for residential energy efficiency in the Oberlin community; new opportunities for financial and energy savings through vehicle collaboration within Lorain County; and decreased reliance on fossil fuels and expanded production of renewable energy in the region. The dissemination conference and the summary report developed for the conference also benefited the public, but making the findings and recommendations of the regional studies broadly available to elected officials, city managers, educators, representatives of the private sector, and the general public.

**5. Provide a comparison of the actual accomplishments with the goals and objectives of the project.**  
A chart comparing actual accomplishments with the goals and objectives of the project follows.

Organization	Project Description	Project Activity Category	Goals/Objectives	Accomplishments and Impact	Problems
AMP	Elmore - Lighting Project	2	Install more efficient street lighting to reduce energy use.	Efficient street lighting was installed, reducing energy use.	Elmore originally proposed upgrading a re conductor and loop distribution as its infrastructure project but subsequently requested and received approval from NETL to install energy-efficient street lighting.
AMP	Oak Harbor - Lighting Project	2	Install more efficient street lighting to reduce energy use.	Efficient street lighting was installed, reducing energy use.	
AMP	Oak Harbor - Distribution Project	2	Upgrade the distribution circuit to improve the reliability of electricity transmission to the Village of Oak Harbor.	The distribution circuit was updated, improving the energy infrastructure and safety for utility workers and residents.	
AMP	Wellington - Lighting Project	2	Install more efficient street lighting to reduce energy use.	Efficient street lighting was installed, reducing energy use.	
AMP	Wellington - Electric Vehicle/Solar Photovoltaic Project	2	Install solar photovoltaic panels to offset the "fuel" usage of an electric vehicle used by the Village of Wellington public utility.	An electric vehicle was purchased, and solar photovoltaic panels were installed on the roof of the utility's maintenance building, increasing generation of renewable power.	
Barr Engineering	Oberlin College Electric Distribution Study	3	Assess the stability of the electric grid on the Oberlin College campus for future electric loads on the campus.	The study found that if the College's coal-fired central heating plant were replaced with electric ground-source heat pumps, the distribution system would need to be updated. Results of study informed College planning for replacement of coal-fired central heating plant.	
Brown and Caldwell	Waste Heat from the Landfill for use at the Waste Water Treatment Facility and Future Greenhouses	3	Assess the amount of waste heat available at the landfill and the feasibility of installing a heat exchanger and piping the heat to the waste-water treatment facility to use in an existing biodigester process.	The type of heat exchanger and heat transfer fluid were determined. The piping was sized, and a cost estimate was developed. The study also indicated that the amount of heat available from the electric generators exceeds the energy needs of the City. Phase II of the project will examine potential additional uses for the heat as well as develop a detailed engineering study.	
Center for Neighborhood Technology	Carbon-neutral transportation plan for the City of Oberlin	3	Develop carbon-neutral transportation plan for the City of Oberlin.	The plan was used to develop the transportation section of the City of Oberlin's Climate Action Plan, and it led to the decision to host a Complete Streets Workshop focused on making transportation policies in the City include the needs of bicyclists, pedestrians of all ages, and public transit riders as well as those of drivers.	
Clean Energy Coalition	Assessment of fleet vehicle fuel reduction and collaboration feasibility	3	Calculate the baseline fuel usage for the City of Oberlin and nine project partners (Oberlin City Schools, Oberlin College, Lorain County Joint Vocational School, Lorain County Community College, Kendal at Oberlin retirement community, Republic Waste Management, Lorain County Metro Parks, Horton Custom Cleaning, and New Russia Township) to explore the possibility of vehicle sharing and collaboration.	Information about vehicle use was collected from participating organizations, with data gathered about the types of vehicles owned, the amount and type of fuel used, and plans for vehicle replacement. This information was subsequently used in a grant application from the City of Oberlin to the Ohio Department of Development. A grant of \$86,180 was awarded to support the next phase of work on the project.	
Complete Streets Coalition	Complete Streets Workshop	3	Educate decision makers in Oberlin and the broader Lorain County community about Complete Streets approaches, which call for transportation policies that consider the needs of pedestrians, bicyclists, and public transportation as well as drivers.	Information gathered through the workshop informed the development of a resolution for Oberlin City Council. With the intention of passing a Complete Streets policy requiring inclusive design for all users – including bicyclists, public transit and pedestrians of all ages and abilities as well as drivers – the resolution will go before Oberlin City Council in 2013.	
Green Energy Ohio	Quantify possible energy output for Northwest Ohio	1	To quantify the amount of solar and wind energy that could be generated in northwest Ohio.	Maps of solar and wind output for northwest Ohio were created and used to calculate a theoretical output for the area. It was determined there is sufficient wind and solar energy to meet the current electricity demand for the area.	
Green Energy Ohio	Map out solar photovoltaic and wind supply chain	1	Interview hundreds of companies that are part of the wind and/or solar photovoltaic supply chain. Highlight useful business information for future cluster development.	The study showed that northwest Ohio has an opportunity to become a cluster for wind development and is already a growing region for solar development. The study found that many companies that identify themselves as part of the solar or wind supply chain are small businesses employing 10 to 20 people.	
Masi Consulting	Small-scale biodigester feasibility and options for Oberlin	1	To assess the types of small-scale biodigesters that could be used at a community scale with the input being food waste.	Multiple options were for development were identified and examined. Given the size of the Oberlin community (~8,000), the population would not generate the food waste necessary for a biodigester with the capacity to generate electricity or vehicle fuel. The most promising model identified would be to use food waste at the waste-water treatment plant in a simple composting operation or to mix it with biosolids for use in the existing biodigester.	
Nancy London	Conference report for distribution	4	To summarize all of the studies and assessments undertaken in the first year of the grant.	A report summarizing the findings of the district-wide studies work done in the first year of the grant was developed and provided to government officials, policymakers, educators, and business people who attended the September 2011 conference on the Oberlin College campus through the grant. A PDF of the report is available for free download at <a href="http://www.oberlinproject.org/images/policy-library/NETL%20Oberlin%20Report.pdf">http://www.oberlinproject.org/images/policy-library/NETL%20Oberlin%20Report.pdf</a> on the website of the Oberlin Project, a collaboration of the City of Oberlin and Oberlin College to move the community to climate positivity.	
Ohio Environmental Council	Development of a Residential Energy Efficiency Program	3	To assess the barriers to residential energy efficiency and develop a program to reduce these barriers and encourage residents to improve energy efficiency.	On the basis of the report, a residential energy efficiency program was developed and is being piloted by a local non-profit, Providing Oberlin with Efficiency Responsibly (POWER).	
Palmer Energy	Calculate the amount of energy (electricity and natural gas) used in northwest Ohio.	1	To quantify the amount of energy being used in northwest Ohio, what types and the end use.	The amount of electricity and natural gas used in northwest Ohio was calculated. The origin and end use sector were also identified (residential, commercial, industrial).	
Policy Matters Ohio	A policy platform for the City of Oberlin	3	To develop for the City of Oberlin an energy-policy platform that articulates strategies for moving the City entirely to renewable energy sources and climate positivity.	The energy policy platform includes a ten-point action plan for transforming the City of Oberlin to a climate positive City by 2050.	

Professional Supply Inc.	Energy Assessments of 4 small commercial buildings in downtown Oberlin	3	To perform energy audits on 4 small commercial buildings in downtown Oberlin and to make recommendations for energy saving measures.	Energy audits were completed on four commercial buildings – a restaurant; a multi-unit building that includes a bank; the public library; and a multi-unit building that includes a restaurant – and energy-savings strategies were identified. The most common recommendation was that new, energy-efficient lighting being installed.	The heating/ventilation/air conditioning (HVAC) systems and equipment in older buildings were not designed to cycle in fresh air, since such circulation occurred naturally given the porousness of building envelopes resulting from construction practices of the time. As greater emphasis has been placed on energy efficiency, far less air passes through the building envelope, and HVAC systems are required to circulate fresh, outdoor air into the building. With this change to building code, owners or tenants often see an increase in heating and cooling bills with the installation of new HVAC systems.
Solutions in Sustainability	Calculate the amount of farm and food-processing waste generated in northwest Ohio	1	Through interviews and collection of data, assess the amount of farm and food-processing waste generated in district OH-09 and the potential energy that could be generated from the waste.	Extrapolation methodologies were developed based on literature and prior waste-stream studies, and estimates of food processing waste were created and validated.	Solutions in Sustainability researchers attempted to collect primary data but could not gather a sufficiently large sample.
Solutions in Sustainability	Biodigester case study of a dairy farm in the region	3	To determine the amount and quality of the cow manure at the farm and financial viability of a biodigester project.	The assessment was positive, indicating that the farm has enough waste to pursue an economically attractive project. The findings are a useful case study for the region, which has many dairy farms.	
Sommer Electric	Assess energy savings potentials for Oberlin College through energy-efficient lighting retrofits	3	Gather data and analyze the current lighting systems in multiple buildings on the Oberlin College campus, recommend more efficient lighting schemes and calculate the capital cost and return on investment for said upgrades.	Data about indoor lighting systems in 21 Oberlin College buildings and residence halls (a total of 690,555 square feet) were collected and analyzed. Retrofitting all 21 buildings would result in an annual energy savings of \$65,269.42 and 104,816 watts with a simple payback of 3.2 years after utility rebates. The College has begun lighting retrofits on the basis of the findings, to reduce energy use and yield financial savings.	
Sunwheel	Feasibility studies for roof-mounted photovoltaic arrays, ground-mounted solar photovoltaic arrays, and wind energy for northwest Ohio and the Oberlin region.	1	Create userguides for permitting, zoning, regulations, costing, etc. for solar photovoltaic and wind projects for communities in northwest Ohio	This report documented the viability of photovoltaic arrays as renewable energy sources for northwest Ohio and the Oberlin region. On the basis of the findings, with non-grant funds, Oberlin College and the City of Oberlin E10a solar photovoltaic field north of campus that connects with Oberlin Power and Light, with renewable energy generated sold to the College.	

**6. Summarize project activities for the entire period of funding, including original hypotheses, approaches used, problems encountered and departure from planned methodology, and an assessment of their impact on the project results. Include, if applicable, facts, figures, analyses, and assumptions used during the life of the project to support the conclusions.**

The previous chart summarizes activities for the entire period of the grant, approaches used, problems encountered, and the impact of project results. Given the nature of the studies, which included infrastructure assessments, alternative-energy transmission studies, and energy assessments, hypotheses were not relevant and not included in the statement of project objectives. The planned methodologies were used to undertake the four areas of grant activity, with research the method for activities 1 and 3 (district-wide energy infrastructure assessments and alternative-energy transmission studies and Oberlin, OH-area energy assessment initiatives, respectively); infrastructure implementation for activity 2; and education for activity 4 (dissemination conference and report).

**7. Identify products developed under the award and technology transfer activities, such as:**

**A. Publications**

- Free, downloadable PDF of the summary report of the district-wide studies:  
<http://www.oberlinproject.org/images/policy-library/NETL%20Oberlin%20Report.pdf>
- Free, downloadable PDF of the report by Palmer Energy Company on energy demand and consumption in Ohio's 9<sup>th</sup> District:  
<http://www.oberlinproject.org/images/policy-library/Palmer%20Energy%20Report%20-%209th%20District%20Energy%20Report%20Final%20Sept%202011.pdf>
- Free, downloadable PDF of the study by the Ohio Environmental Council about barriers to residential energy efficiency and recommendations for launching a residential energy efficiency program in Oberlin, OH:  
<http://www.oberlinproject.org/images/policy-library/Oberlin%20Residential%20Energy%20Efficiency.pdf>
- Free, downloadable PDF of the energy-efficient transportation plan for Oberlin and Northern Ohio developed by the Center for Neighborhood Technology:  
<http://www.oberlinproject.org/images/policy-library/Oberlin%20Residential%20Energy%20Efficiency.pdf>
- Free, downloadable PDF of the evaluation of wind and solar resources for Ohio's 9<sup>th</sup> Congressional District by Green Energy Ohio:  
[http://www.oberlinproject.org/images/policylibrary/9th%20Congressional%20District%20Wind%20Solar%20Resource%20Report\\_Oberlin%20DOE%20Grant.pdf](http://www.oberlinproject.org/images/policylibrary/9th%20Congressional%20District%20Wind%20Solar%20Resource%20Report_Oberlin%20DOE%20Grant.pdf)
- Free, downloadable PDF of “Ohio’s 9<sup>th</sup> District: Existing and Future Job Creation Opportunities: PV and Wind Supply Chains” by Green Energy Ohio:  
[http://www.oberlinproject.org/images/policylibrary/Compilation%20of%20Companies%20in%20the%209th%20District\\_07.08.11.pdf](http://www.oberlinproject.org/images/policylibrary/Compilation%20of%20Companies%20in%20the%209th%20District_07.08.11.pdf)
- Free, downloadable PDF of evaluation of the capacity to deploy solar and wind technologies in Ohio’s 9<sup>th</sup> Congressional District by Green Energy Ohio:  
[http://www.oberlinproject.org/images/policylibrary/Final%20Report\\_9th%20Congressional%20District%20Capacity%20to%20Deploy%20Renewables\\_09.30.11.pdf](http://www.oberlinproject.org/images/policylibrary/Final%20Report_9th%20Congressional%20District%20Capacity%20to%20Deploy%20Renewables_09.30.11.pdf)
- Free, downloadable PDF of “Local Sustainability: Menu of Options” by Policy Matters Ohio:

[http://www.oberlinproject.org/images/policylibrary/OberlinMenuOfPolicyOptions2011\\_0524.pdf](http://www.oberlinproject.org/images/policylibrary/OberlinMenuOfPolicyOptions2011_0524.pdf)

- Free, downloadable PDF of “Wind Power Demonstration Project Report for Oberlin, Ohio and other AMP-Member Ohio Communities” by Sunwheel Energy Partners and Sustainable Community Associates:  
<http://www.oberlinproject.org/images/policy-library/Wind%20Power%20Demonstration%20Project%20Report%20-%20March%201%202011.pdf>
- Free, downloadable PDF of “Solar Power Demonstration Project Report: Roof-Mounted Solar Installations” by Sunwheel Energy Partners and Sustainable Community Associates:  
<http://www.oberlinproject.org/images/policy-library/Solar%20Power%20Demonstration%20Project%20-%20Roof%20Mounted%20Solar%20-%20Oberlin.pdf>
- Free, downloadable PDF of “Solar Power Demonstration Project Report: Solar Farm Installations: Oberlin, Ohio and Other AMP-Member Ohio Communities” by Sunwheel Energy Partners and Sustainable Community Associates:  
<http://www.oberlinproject.org/images/policy-library/Solar%20Power%20Demonstration%20Project%20-%20Field%20Mounted%20Solar%20-%20Oberlin%20-%20v1.pdf>
- Free, downloadable PDF of “Biogas and Anaerobic Digestion Final Report” by Solutions in Sustainability:  
<http://www.oberlinproject.org/images/policy-library/110822%20OC%20NETL%20Final%20Report.pdf>
- Free, downloadable PDF of “Waste Heat Utilization Feasibility Study” by Brown and Caldwell:  
<http://www.oberlinproject.org/images/policy-library/OberlinHeatUtilizationMemo121412.pdf>

B. Website

- Information about energy research and policy studies through the grant:  
<http://www.oberlinproject.org/research-and-policy/energy>
- Agenda for the September 16, 2011 conference “Northern Ohio’s Clean Energy Future: Regional Prosperity, Opportunity, Leadership”:  
<http://new.oberlin.edu/office/community-and-government-relations/energy-conference/agenda.dot>

C. Networks or collaboration fostered – The City of Oberlin and nine partners (the Oberlin City Schools, Oberlin College, Lorain County Joint Vocational School, Lorain County Community College, Kendal at Oberlin retirement community, Republic Waste Management, Lorain County Metro Parks, Horton Custom Cleaning, and New Russia Township) are exploring the possibility of vehicle sharing and collaboration. Data gathered through the study exploring collaboration were used in a subsequent grant application to the Ohio Department of Development’s Local Government Innovation Fund (LGIF), which awarded \$86,180 for further development of the project.

D. Technologies/techniques – not applicable

E. Inventions/patent applications – not applicable

F. Other products – not applicable