100% Renewable Energy Plan for Leelanau County, MI

Northport Energy

University of Michigan

School for Environment and Sustainability

Team Members: Abhijeet Walchale, Brandon T. Smith, Leona Liu
Advisors: Dr. Geoffrey Lewis, Dr. Gregory Keoleian

July 25, 2018 (Revised)

Introduction

There is a growing need to transition to 100% electrical energy generated from renewable energy sources, mainly wind, water and solar (WWS). Some suggest that it will be straightforward to meet future energy demands through wind-water-solar with a relatively small footprint (Jacobson and Delucchi, 2010), while others point out that the current penetration of variable renewable energy sources in most power systems is limited to 20% (Zaman, 2018). Apart from the adoption of renewable energy resources, it is also desirable to reduce peak energy demand through energy storage. In addition, understanding electric vehicle demand is fundamental to begin the transition toward electricity generation that encompasses the future needs of the transportation sector.

A previous Master's Project, conducted by students in 2015 from the School of Natural Resources and Environment (now SEAS) at the University of Michigan, assessed the renewable energy resources available to the Northport community, including solar radiation and wind potential (Cecco et al., 2015). Based on the community engagement survey from this project, a second project in 2017 conducted a commercial energy use survey (Blanchard, 2017). The results suggested that both residential and commercial sectors were supportive toward renewable energy. Building on these previous studies, this project aims to expand the Northport 100% renewable energy plan to the entirety of Leelanau County and develop a comprehensive strategy to achieve such a plan.

Project Objectives and Scope

This project is an extension of the 2015 SEAS student project titled "Northport 100% Renewable Energy Feasibility Study, developing a 100% renewable electricity plan for the Leelanau County, MI" and also draws on the 2017 practicum titled "Property Assessed Clean Energy (PACE) Renewable Energy Project Plan and Pilot Project." This project will develop a renewable energy resource assessment for Leelanau County and will also assess how the extensive adoption of electric vehicles in the County will impact the 100% renewable electricity plan. The renewable electricity sources under consideration will be solar photovoltaic and wind energy, with an additional component considering energy storage options.

<u>Objective 1: Countywide Resource Potential Assessment</u>

The 2015 project adequately assessed resource potential available within the Northport community and the immediately adjacent areas. The project did not assess the potential for the rest of Leelanau County. While resource potential can generally be estimated for the rest of Leelanau County, a full-scale viability and siting assessment has not been performed. This objective within the project will provide viable wind and solar resource

potential for Leelanau County and will include GIS analysis. The resource assessment will take into account surrounding environmental and topological conditions to provide a realistic and attainable resource estimation for renewable energy deployment in the county.

Objective 2: Energy Storage Assessment

One aspect of renewable energy generation that must be considered in a 100% renewables plan is that of energy storage. Due to the variability of renewable resources, energy storage helps meet peak demands and periods of lower generation from renewables. Current grid infrastructure does not have the capacity to store additional energy, so an investigation into storage technology will be coupled with consumption data for Leelanau County to produce an initial estimate for sizing grid storage.

Objective 3: Electric Vehicle Demands

Over the next several decades, it is expected that a larger volume of electric vehicles (EVs) will be in operation on America's roadways, as the market shifts away from dependency on fossil fuels. This objective within the project aims to forecast growth in the daily electricity demand requirements from EVs within Leelanau County, which will be incorporated into the 100% Renewable Energy Plan. The energy storage capabilities of EVs will be considered under Objective 2.

Objective 4: 100% Renewable Energy Plan

As the final component of the project's contribution to Northport Energy and Leelanau County, a comprehensive 100% Renewable Energy Plan document will be prepared. Incorporating the objectives listed above, the Plan will provide concrete, achievable targets to securing a 100% renewable energy portfolio within the next 10 years. Specific goals will be provided, as well as estimates for expected energy consumption within the county over a decade.

Deliverables/ Impact

The first deliverable will be two public presentations given to the Northport community and Leelanau County residents. The first presentation will be an introduction to the project and the project team, describing our goals, methods of analyses, and expected outcomes. The second presentation will be delivered after the completion of the project, and will be a comprehensive overview of the project's findings. The dates of the presentations are yet to be determined.

In addition to the public presentations, a final Renewable Energy Plan will be presented to Northport Energy and Leelanau County. This Plan will outline what initiatives should

be taken over the next decade to achieve a 100% renewable energy portfolio. Components of the final Plan will include:

- Maps of Leelanau County, showing the potential renewable resources (wind and solar) based on location data for resource availability. These maps will be indicative of potential areas for development of renewable energy within the county, and which sites may be better suited for larger projects.
- A comprehensive plan for the county to achieve 100% renewable energy by 2030, based on population data and per capita annual energy consumption for both the residential and commercial sectors. The Plan will offer concrete, achievable measures that can be carried out within the county in pursuit of the 100% renewable energy target. The Plan will include a recommended energy portfolio and highlight any additional considerations that need to be addressed.
- Assessment of increased EV use and estimated county-wide consumption projections and storage capability. In addition, these projections will include concerns for grid infrastructure and potential problems with availability and/or access to charging stations.
- Analysis concerning the options and capacities for various energy storage technologies. Considered strategies may include, but are not limited to, pumped hydroelectric storage, compressed air storage, utility-scale battery storage, domestic battery systems, and EV storage strategies.
- A preliminary financial analysis for large-scale renewable energy installations, as well as operations and maintenance cost forecasting and potential financial concerns.

Research Approach

1) *Demand estimation using Northport data and residential and commercial demand data from utilities*. Electricity consumption data with summer and winter peaks is available for the county through the two electricity providers in the region, Consumers Energy and Cherryland Energy Cooperative.The Northport 100% Renewable Energy Feasibility Study provides insights into energy consumption and expected increase in consumption over time for Northport Township. These data can be used to estimate the growth trend for electricity in the entire county.
2) *Analysis and comparison of different renewable energy sources*. Energy potential for solar energy and wind energy will be assessed and feasibility of deployment will be evaluated for Leelanau County. Wind resources in the Grand Traverse region are well-studied, and previous methods and data can be used to develop a countywide resource potential assessment.

3) *Scenario Development and Demand estimation for Electric Vehicles*. In order to estimate the increase in electricity demand attributed to electric vehicles, real-time battery charging data from the monitoring system at client sites of Leelanau Solar will be used to evaluate the demand increase related to one electric vehicle. The consumption pattern, with projections of EV deployment in the county, will then be extrapolated to establish the overall maximum electricity demand.

4) *Assessment of grid requirements and financial burdens.* After assessing the potential of energy resources for the county, grid upgrade requirements for the increased distributed generation will be evaluated and included in the financial analysis of renewable energy technologies.

5) *Primary assessment and estimate of required grid energy storage options.* Based on the electricity demand and the potential renewable resources, assess the amount of energy storage requirements, along with the amount of storage provided by the estimated EV fleet.

Project Timeline

Dates	**Description of Goals / Milestones**
July, 2018	Analyze population growth for Leelanau County; Identify composition of residential and commercial sectors within the county; Develop EV demand parameters
July-August, 2018	Renewables potential resource assessment; Development of resource maps and analysis of consumption data
September - December, 2018	Finalize analysis of consumption data; Conduct research on energy storage and assess options for Leelanau county
October 2018	Presentation #1: Leelanau County League of Women Voters (Date TBD)
January - February, 2019	Finalize resource potential maps and siting potentials; Financial impact assessment
February - March, 2019	Development of 100% Renewable Energy Plan and target deadlines; Write final report and do supplementary research, if needed; Second Presentation in Leelanau County (Date TBD)
April, 2019	Final amendments and editing of the report and presentation of research

Major Resources Needed

1) Access to consumption data / methods to obtain data via utility requests
    - Electricity Consumption Data: We already have Cherryland Electric Cooperative (CEC) data for most of Leelanau Township (not county) roughly 500 homes and some small commercial as well as the load curves for the LL1 circuit. These data come from the Lake Leelanau Substation, circuit #1, LL1 that runs up the middle of the county from near the village of Lake Leelanau. We still need data from CEC for the other substations and circuits (LL2 and LL3). Consumers Energy electricity sales for Northport in zip code 49670 are available. We need to get data in other zip codes in the county.
    - Energy Production by Solar Panels: Monthly and yearly production (kWh) is provided by three solar dual axis trackers which is available online.
    - Wind Resource Potentials: Michigan Automated Weather Network (MAWN) provides daily data of wind speed that we can use. There are three stations in eastern Leelanau County.
2) Topic expertise, via our clients or advisors
    - Resource potentials and siting map development: We need to learn GIS and other relative tools in order to conduct spatial analysis and mapping.
    - Energy storage: Storage technologies and applications.
3) Access to programs / other data resources: SAM, NREL, EIA, IEA, etc.
4) Financing: gas money, car rentals, housing, etc.

References

Jacobson, M. Z., & Delucchi, M. A. *Providing all global energy with wind, water, and solar power, Part I: Technologies, energy resources, quantities and areas of infrastructure*, and materials. Energy policy, 39(3) (2011), 1154-1169.

Zaman, A. *100% Variable Renewable Energy Power Systems: Survey of Possibilities*. University of Michigan School for Environment and Sustainability. April, 2018.

Cecco, L., Chen, Y., Good, J., Lai, K., Loshakova, E., Weinberg, E. *Northport 100% Renewable Energy Feasibility Study*. University of Michigan School of Natural Resources and Environment. April, 2015.

Blanchard, R. *Property Assessed Clean Energy (PACE) Renewable Energy Program Plan and Pilot Project.* University of Michigan School of Natural Resources and Environment. April, 2017.

Appendix A: Researcher Profiles

Abhijeet Walchale

Abhijeet is from Mumbai, India. He has a Bachelor of Engineering in Electrical Engineering from the University of Mumbai and Post-Graduate Diploma in Thermal Power Plant Engineering from the National Power Training Institute. He worked as a Operations and Maintenance Executive for a 600 MW coal-fired power plant in India. He is also a certified Solar Photovoltaic Installer from the Government of India. He is interested in working on renewable integration into the grid. In his free time, Abhijeet is a photographer and loves traveling.

Brandon Smith

Brandon is from the Greater Cleveland Area in Ohio. He received his Bachelor of Science degree in Geology from Kent State University, and his graduate interests include the integration of alternative energy resources into grid infrastructure, and the application of small-scale energy initiatives for residential / rural areas. In his free time, Brandon likes to play board games and go trekking.

Leona Liu

Leona is from Mianyang, Sichuan province in China. Leona is a dual-degree Master's student in Sustainable Systems and Environmental Engineering. She received her Bachelor of Environmental Engineering from the Beijing Normal University. Her graduate interests include renewable energy systems and circular economies. In her free time, Leona loves to listen to music and taking pictures.