2023

Decarbonization Plan Summary

NATIONAL PARKS OF LAKE SUPERIOR

PREPARED FOR:
NATIONAL PARKS OF LAKE SUPERIOR FOUNDATION (NPLSF)

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NATIONAL PARKS OF
LAKE SUPERIOR
FOUNDATION

From the unique ecosystem of Isle Royale National Park to the historic lighthouses of the Apostle Islands National Lakeshore, Lake Superior's five National Parks boast natural and cultural resources cherished by generations. The park facilities, however, run primarily on fossil fuels which are a major source of carbon pollution. This must change.

With 10% of the world's freshwater, the majestic Lake Superior and its National Parks are facing the ravages of a changing climate. We owe it to the lake, the parks, and ourselves to create a clean future free of carbon pollution.

Our answer: *Decarbonize the Parks*—an ambitious project to cut carbon pollution from park facilities and pursue net-zero energy consumption. The National Parks of Lake Superior (NPLSF) is leading a national coalition of public and private agencies, nonprofits, and individuals committed to eliminating fossil fuel consumption from the treasured parks that ring Lake Superior. Our priorities are to:

- Utilize industry-leading technical design
- Create a realistic, practical example of climate resiliency to educate and inspire others
- Elevate clean energy jobs
- Build an equity and inclusion lens into all aspects of the project

This report is the first step in the journey. It outlines our Decarbonization Plan to address the unique needs of each park with a combination of tools, from zero-carbon energy sources and energy efficiency upgrades to new high-impact, cost-efficient proven technologies.

Our deepest thanks go to Askov Finlayson for making this report possible. Askov Finlayson is a climate positive winter outerwear brand based in Minneapolis, Minnesota. As part of their mission to Keep The North Cold, Askov Finlayson supports leading-edge solutions to the climate crisis through their Give 110% grantmaking program, resulting in over $1M in donations. We remain incredibly grateful for their generous support from the earliest stages of this project.

We also want to thank our partners at Willdan for their in-depth, meticulous, and inspired work in producing this report, as well as the U.S. National Park Service (NPS), the National Park Foundation (NPF), and the National Parks Conservation Association (NPCA) for their support in preserving our public lands through climate-resilient practices.

Above all, we extend our sincere gratitude to the superintendents and staff of the five National Parks of Lake Superior. It is only through their partnership and hard work that we can create and implement a decarbonization model that is ambitious, effective, and equitable. It is our hope that this will serve as an inspirational example for others to follow.

Tom Irvine, Executive Director

Executive Summary

Our National Parks, including those supported by the National Parks of Lake Superior Foundation (NPLSF), are a living symbol of the majesty of unspoiled lands across the United States. The experience of visiting these parks can help people transcend day-to-day challenges, provide sanctuary, and inspire life-long pursuits.

Each year, millions of guests visit the five National Parks of Lake Superior, which presents an opportunity to demonstrate the importance of environmental stewardship from the very moment visitors step into the wonder of these incredible natural and cultural surroundings. Taking advantage of this opportunity, we developed this Decarbonization Plan to reduce greenhouse gas (GHG) emissions and pursue net-zero energy consumption for buildings and land transportation across the five National Parks of Lake Superior. These parks are:

- Apostle Islands National Lakeshore
- Grand Portage National Monument
- Isle Royale National Park
- Keweenaw National Historical Park
- Pictured Rocks National Lakeshore

This Decarbonization Plan includes proven technologies that will not compromise park operations, comfort, or usability, and includes measures such as electric vehicles (EVs), cold-climate air-source heat pumps (cc-ASHPs), solar photovoltaics (PV), and battery energy storage.

To avoid the most catastrophic impacts of climate change, now is the time to act if we are to reduce global GHG emissions by 43% by 2030 and 85% by 2050.[1] Funding opportunities through the 2022 Inflation Reduction Act (IRA) and the Infrastructure Investment and Jobs Act (IIJA) provide affordable options to achieve the plan. Implementation of this Decarbonization Plan can also serve as a demonstration of solutions that can be implemented in other parks and regions across the United States.

This Decarbonization Plan was developed in a three-step process:

1. **The Decarbonization Plan Kickoff** was held with key stakeholders to determine the plan's vision and scope.

2. **A Demand-Side Energy Assessment** was performed to identify strategies to reduce building energy demand and convert fossil fuel demand to electric demand.

3. **A Supply-Side Energy Assessment** was performed to identify strategies to supply the parks with carbon-free renewable energy and provide lifecycle and capital cost estimates for various combinations of demand-side and supply-side solutions.

The project authors, Willdan Energy Solutions (Willdan) and Energy + Environmental Economics (E3), are national leaders in decarbonization and transitioning to a clean energy future with deep regional experience. Willdan has analyzed demand-side decarbonization options for 3,000+ buildings in the upper

[1] Recommendation from the United Nation's IPCC: Window to avert catastrophic climate change is quickly closing

Midwest. E3 has provided supply-side analyses to help utilities, local governments, and large energy users develop decarbonization plans. Working together, Willdan and E3 found that the National Parks of Lake Superior can achieve a 93% reduction in GHG emissions at a savings of $2.7 million over 25 years and can fully decarbonize for an incremental cost of $3.5 million over 25 years when compared to current operations. The lifecycle cost analysis considered capital costs, equipment replacement costs, operations and maintenance (O&M) costs, and energy costs and discounted them to their equivalent value in today's dollars.

Our key findings:

- The parks can achieve 93% decarbonization for a capital investment of $10.4 million and over 25 years will:
  - Eliminate nearly 30,000 tCO_2-equivalent emissions
  - Reduce operating costs by $5.6 million
  - Save $2.7 million in total lifecycle costs compared to current operations
- The parks can achieve 100% decarbonization for a capital investment of $15.3 million and over 25 years will:
  - Eliminate nearly 32,000 tCO_2-equivalent emissions
  - Reduce operating costs by $4.9 million
  - Cost $3.5 million more in total lifecycle costs compared to current operations

The lifecycle emissions and costs are shown in Figure 1. Achieving 100% decarbonization is significantly more expensive than achieving 93% decarbonization because of the large solar arrays and battery energy storage systems (BESS) needed to meet the energy demand for the off-grid locations in all conditions. The 93% and 100% scenarios are not the only options for the parks; available space for solar arrays and/or economic constraints for each park will affect the ultimate reduction in emissions.

Figure 1. Lifecycle GHG Emissions and Costs

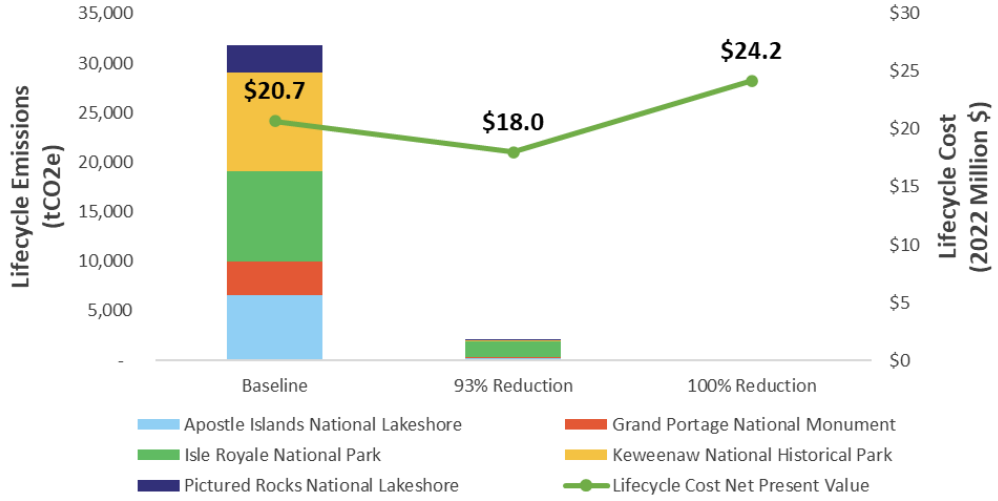
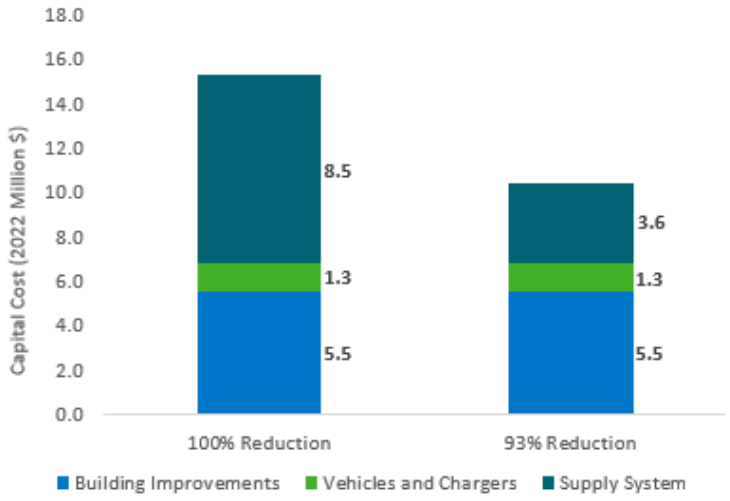


Figure 2. Capital Costs



Note comparative costs for full and nearly-full decarbonization:

- 93% decarbonization for $10.4 million
- 100% decarbonization for $15.3 million

The difference in supply system costs is driven by the large solar arrays and battery energy storage systems needed to meet the energy demand during all conditions for the off-grid locations in the 100% Reduction scenario.

The decarbonization does not have to be either 93% or 100% - it is on a continuum with these two levels illustrating two possibilities.

Figure 2. Locations of the National Parks of Lake Superior[2]

[2] National Parks of Lake Superior Foundation, https://www.nplsf.org/national-parks-of-lake-superior

Decarbonization of the facilities in the five National Parks of Lake Superior includes three coordinated activities:

(1) Improving the energy efficiency of the facilities while eliminating (where possible) all direct fossil fuel combustion,
(2) Replacing internal combustion engine vehicles with electric vehicles and providing electric vehicle charging infrastructure, and
(3) Developing a fossil fuel-free energy supply system to serve the facilities. These coordinated decarbonization strategies will reduce greenhouse gas (GHG) emissions and maintain a high level of reliability in a cost-effective manner.

Conclusion

By decarbonizing the five National Parks of Lake Superior, National Park Service (NPS) leadership can take the next step in protecting our natural environment and setting a standard for other parks to follow. Decarbonization is critical to preserve the parks and their resources for visitors and future generations to enjoy and learn from. With cost-effective solutions and funding opportunities currently available, now is the time to meet this challenge.

To learn more, or to see the full report, please contact the National Parks of Lake Superior Foundation at decarb@nplsf.org.

Appendix: Scope of Work by Park

Apostle Islands National Lakeshore

Apostle Islands National Lakeshore (APIS) includes lakeshore on the mainland and 22 islands. The mainland facilities are grid-tied, and the islands are off-grid. Mainland facilities are open year-round, while island facilities are open May through October. Existing facilities range from a century-old courthouse to a new Leadership in Energy and Environmental Design (LEED)-certified visitor center.

To decarbonize the park, NPS will need to:

+ Retrofit 19 buildings to cc-ASHP, heat pump water heaters, and LEDs
+ One or two solar arrays for grid-tied locations (no battery storage)
    - There are two different power companies (Xcel Energy and Bayfield Electric Cooperative), so the park may need separate arrays for each area
    - 273 kW estimated solar capacity
        - 220 kW for Xcel Energy facilities and 53 kW for Bayfield Electric Cooperative facilities
        - Solar arrays sized to provide 100% of the total annual electricity load
    - Programs to purchase renewable energy through the utility companies are also available
+ Nine solar arrays plus storage distributed across nine off-grid locations
    - Estimated system size: 90 kW solar, 62 kW battery
    - These estimates are based on an assumed existing system size of 65 kW solar and 18 kW battery, which was estimated based on the assumption that the current system always covers the load without generator backup. The actual existing solar and battery system sizes are unknown.
    - Propane generators will be maintained for backup but will only provide power in emergencies.
+ Replace all ICE vehicles with EVs: 6 large vehicles and 6 medium vehicles
+ EV charging stations for 12 vehicles

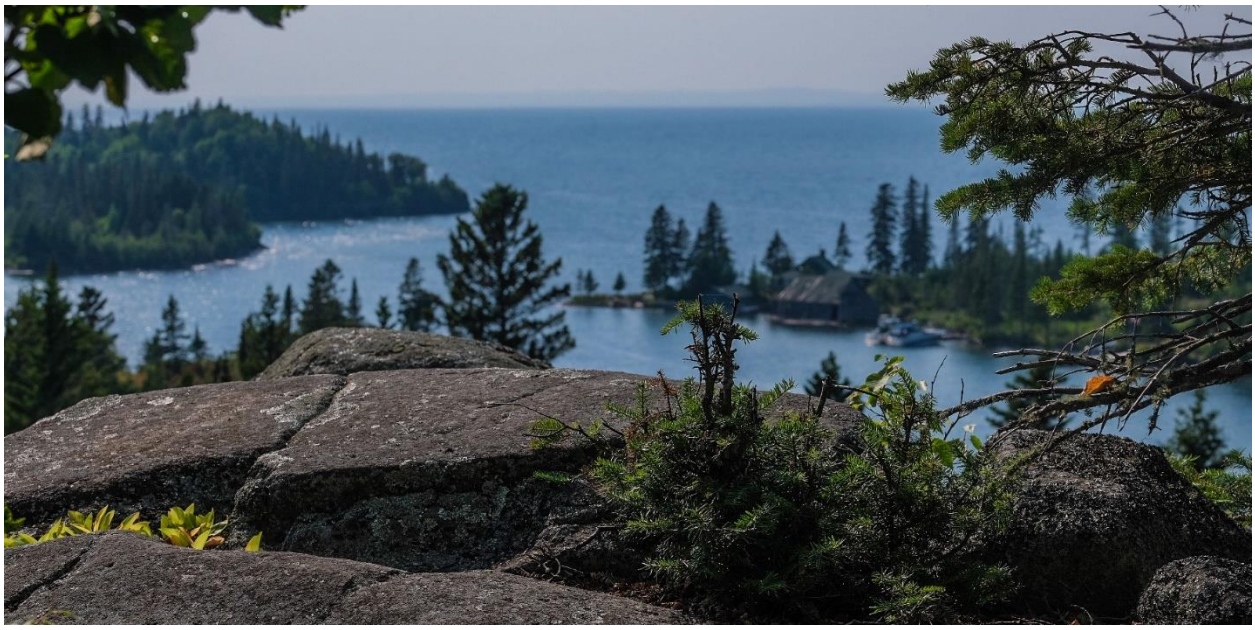
Grand Portage National Monument

Grand Portage National Historic Monument (GRPO) features a recreation of the historic fur trading depot, visitor center, and surrounding lands. The park is a partnership between the National Park Service (NPS) and the Grand Portage Band of Lake Superior Chippewa. All facilities within the park are grid-tied. The historic depot is open May through October, while the visitor center and other facilities are open year-round. The visitor center and dormitory were recently built with a focus on energy efficiency.

To decarbonize the park, NPS will need to:

- Retrofit 10 buildings to cc-ASHP, heat pump water heaters, and LEDs
- One grid-tied array solar array (no battery storage)
  - 188 kW estimated solar capacity with the array sized to provide 100% of the total annual electricity load
  - Programs to purchase renewable energy through the utility company (Arrowhead Electric Cooperative) are also available
- Replace all ICE vehicles with EVs: 4 large vehicles, 2 medium vehicles, and 4 utility task vehicles
- EV charging stations for 10 vehicles

Isle Royale National Park



Isle Royale National Park (ISRO) is an island chain in Lake Superior and is one of the most remote wilderness areas in the lower 48 states. The National Park Service owns all the facilities but leases lodging, dining, and other facilities to a hospitality provider. ISRO maintains three off-grid electric systems currently powered by diesel generators augmented by solar generation at Rock Harbor and Windigo.

The island facilities are only occupied between May and October except for a small group of researchers involved in the Winter Study.

To decarbonize the park, NPS will need to:

- Retrofit 81 buildings to cc-ASHP, heat pump water heaters, and LEDs. The heat pump sizing is for summer heating, not winter, except for Windigo-New Dorm B0126, QMIS #000126.
- Three off-grid locations: Mott, Windigo, and Rock Harbor
  - Each location will have solar and storage; diesel generators will be maintained for backup but will only provide power in emergencies
  - 1,500 kW total estimated solar capacity, 695 kW total estimated battery capacity
    - The system sizing is optimized based on modeled electricity loads, renewable generation profiles, and system cost estimates. The solar array size is very large in order to meet the load at all times. The required system size may be smaller because actual building loads in October are estimated to be lower than the loads that were modeled.
    - Mott: 640 kW solar, 295 kW battery
    - Windigo: 296 kW solar, 112 kW battery (this value includes 46 kW existing solar that might be replaced)
    - Rock Harbor: 564 kW solar, 288 kW battery (this value includes 119 kW existing solar that might be replaced)
- Replace all ICE vehicles with EVs: 7 utility task vehicles
- EV charging stations for 7 vehicles

Keweenaw National Historical Park

Keweenaw National Historical Park (KEWE) preserves the mining heritage of the region. KEWE is a partnership-based park where many of the facilities are owned and operated by independent partners. For this study, the Quincy Mine Hoist partnership site was included, but other partnership sites were excluded. All park facilities are grid-tied and are operated year-round. All KEWE facilities are historic buildings with varying levels of modernization.

To decarbonize the park, NPS will need to:

- Retrofit six buildings to cc-ASHP, heat pump water heaters, and LEDs
- One grid-tied array solar array (no battery storage)
  - 331 kW estimated solar capacity with the array sized to provide 100% of the total annual electricity load
- Replace all ICE vehicles with EVs: 2 large vehicles, additional vehicles TBD
  - There are likely additional vehicles, but no vehicle data was provided for this analysis
- EV charging stations for 4 vehicles (estimated)

Pictured Rocks National Lakeshore

Pictured Rocks National Lakeshore (PIRO) stretches from Munising, Michigan to Grand Marias, Michigan, and includes 13 miles of cliffs, an inland lake, and hiking trails. The park is owned and operated by the National Park Service. All of the park facilities are on the mainland, but Au Sable Point and the Sullivan seasonal quarters are off-grid. Grid-tied park facilities are open year-round, while off-grid facilities are used May through October. Most PIRO park facilities other than the Munising maintenance facility are historic Coast Guard structures that have been adapted to offices and housing.

To decarbonize the park, NPS will need to:

- Retrofit 15 buildings to cc-ASHP, heat pump water heaters, and LEDs
- One solar array for grid-tied locations (no battery storage)
    - 112 kW estimated solar capacity with the array sized to provide 100% of the total annual electricity load

One or two solar arrays plus storage for off-grid locations

- Estimated system size: 48 kW solar, 24 kW battery
- These estimates are based on assumed existing system sizes of 8 kW solar, 8 kW battery, and 3 kW diesel generator, which were estimated based on the assumption that the current system includes solar, storage, and backup diesel generators to provide power during high load/low solar conditions. The actual existing solar, battery, and generator system sizes are unknown.

- Replace all ICE vehicles with EVs: number of vehicles is unknown
- EV charging stations: TBD, assume charging stations for 8 vehicles

Acknowledgments

This report was produced by Willdan and E3 in collaboration with the National Parks of Lake Superior Foundation (NPLSF) and staff from each of the five National Parks of Lake Superior.

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- National Parks Foundation
- National Parks Conservation Association