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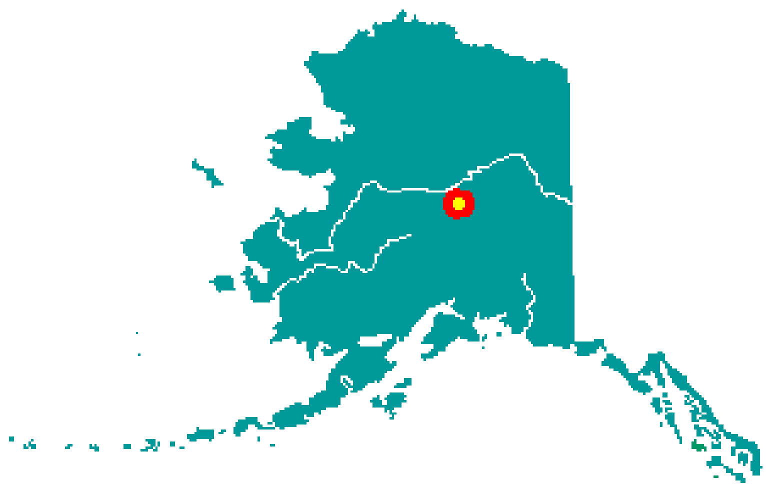
Community Energy Action Plan

Minto, AK



Tanana Chiefs Conference

November 2018

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Introduction

The high cost of energy and living is no surprise to rural Alaska. Simple, efficient design coupled to an innovative mindset is the winning combination that allows us to survive and maintain a quality life in such a unique place with respect to our surroundings.

This Community Energy Action Plan or (CEAP) was designed to produce tangible energy project results for the community. It was created with the cooperative input of your respected community leaders. Use this CEAP as a basic manual to set each action item into motion and to generate conversation with other residents in your community. If you've read this far, that leader is likely you. Keep this CEAP on top of your desk, kitchen table or back pocket. Don't be afraid to wrinkle the pages or get it dirty. It is meant to be used.

The Tanana Chiefs Conference Energy Department is available to assist you with your community energy projects. If you have questions, please don't hesitate to call us at: 452-8251 x3130.

Minto Energy Action Items

New Housing Construction Design Optimization

Minto has been putting in applications for the ICDBG program to expand the electrical distribution system into the airport Heights subdivision with the goal of offering additional housing lots for constructing new housing.

As this conversation progresses, the timing is prime to design for the highest efficiency, durability and indoor air quality while keeping logistic costs to a minimum. TCC Energy works in cooperation with the Cold Climate Housing Research Center and Interior Regional Housing Authority and other housing authorities to provide housing design assistance that is most appropriate for each unique location. When the design assistance is used, each housing unit can be expected to attain a high efficiency 6 star energy rating while holding up reasonably well to hard usage by occupants and maintaining a healthy indoor air environment. The housing materials and construction methods are designed and planned to minimize the cost of logistics and perform well in each respective location.

It is advisable to arrange group meetings with TCC, CCHRC, IRHA and Minto tribal representatives the year before construction begins to ensure design optimization comes to fruition by late Spring. TCC can assist setting this action item in motion by arranging group meetings and acting as a liaison between each respective entity.

Efficient Wood Stove Integration or Change Out

Integrating an efficient wood stove into the design of a new home to offset the consumption of heating fuel is good common sense throughout the interior. Upgrading to efficient catalytic models such as a Blaze King is a great idea if older, inefficient models such as barrel stoves are still used in existing homes.

The TCC Energy Assistance Program can assist with the purchase of efficient wood stoves and the necessary hardware for a safe installation.

For questions how to apply, call TCC Energy Assistance Coordinator, Tawnya Peter at 452-8251 x3457.

Community Wide LED Lighting Upgrade

Converting incandescent or florescent bulbs and fixtures to high efficiency LED units will decrease the electrical load in the village and allow the utility to operate smaller capacity generators which will reduce diesel consumption. This is being done with great success across many interior villages. It will make good sense to upgrade not only the entire community but the airport runway lights as well since they add a significant load to the power generation equipment.

Edwin Bifelt, founder & CEO of Alaska Native Renewable Industries has completed many LED upgrade projects throughout interior villages and is a knowledgeable and experienced contact to assist in spearheading your LED upgrade project. Edwin can be reached at: 687-2296.

Residential Primary Heating System Upgrade

The United States Department of Agriculture can assist with upgrading existing furnaces or boilers to modern efficient units. Applicants must be income eligible to participate and 62 or older for grant based services. If the applicant is under the age of 62, they are eligible for a 1% interest loan that can be applied to a heating system or weatherization building supplies.

For additional information and application assistance, USDA Rural Development Officer, Spud Williams can be contacted at 479-3159

Commercial Energy Audit

The Alaska Energy Authority offers commercial energy audit services to rural communities. AEA covers 75% of the cost and the village is required to contribute the remaining 25%. An energy auditor will identify areas of inefficiency and seek out the best way to achieve maximum building efficiency. The auditor will generate a comprehensive report with a list of cost effective improvements as well as improvements with longer payback periods. An energy audit is a great way to start a building rehab, retrofit, or upgrade. It will tell you exactly how to achieve the most bang for your buck when it comes to building improvements.

AEA Project Design & Environmental Manager, Betsy McGregor can assist with scheduling your energy audit and can be contacted at 771-3957

Power Plant Waste Heat Recovery

The heat produced from the diesel generators in the power plant can be utilized by pumping hot engine cooling fluid to nearby building via a heating circuit. This concept has been successful in many rural communities and helps to reduce the cost of heating public buildings.

Alaska Native Tribal Health Consortium will assist with the feasibility assessment, engineering and construction of a waste heat recovery project. Contact ANTHC Project Manager, Brian Sanford at 729-1900 x5673 for additional information.

Solar Electricity

Solar panels or photo voltaic systems are a proven and reliable means to capture renewable energy throughout interior Alaska. The systems offset electrical consumption and perform best during summer when there is an abundance of sunlight and continue to produce a significant amount of electricity well into the shoulder seasons. Solar energy capacity is growing across interior Alaska and TCC Energy continues to support many villages with their PV projects by assisting with finding sources of funding, procurement, design, and construction. Projects in the TCC region range in size from smaller systems that serve individual buildings up to larger, more sophisticated utility scale systems that serve the whole community.

It is advisable for the village to clearly identify an “energy champion” or individual(s) that have a strong interest in renewable energy and energy efficiency before pursuing a PV project. TCC Energy has had great success working with energy champions in many villages throughout our region. It is a great pleasure to work with such enthusiastic individuals and the success of future projects will hinge upon their contribution.

The community of Minto has expressed a strong interest the development of a large solar PV system in partnership with their local utility, Alaska Village Electric Cooperative. Minto tribe put in an NREL Technical assistance request through the DOE Office of Indian Energy to evaluate a larger solar PV-Diesel system in the community and it was determined that prior to this the community would need to upgrade their switchgear to an auto switchgear and their distribution system to a 3 phase system. That report is attached to this CEAP. TCC Energy will be happy to assist in making it happen.

Residential Energy Audits

The State of Alaska’s funding for the Weatherization program is minimal, but Alaska Community Development Corporation has Federal Funding for Weatherization for low income homeowners. Applications are available for ACDC, and 6-7 homeowners will need to apply to the program before Tanacross can be considered for additional weatherization work. Applications can be found at http://www.alaskacdc.org

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Community-wide Oil Boiler Maintenance

Oil boilers are the backbone of heating systems in remote Alaska. Usually when renewable heating systems are installed, the oil boilers are left in place to serve as a back-up heating source. Because it is unlikely that oil boilers will be replaced in the near future, periodic cleaning and inspection of these boilers should be scheduled on an annual basis. While individual boilers have specific maintenance requirements, there are general recommendations for regular cleaning and inspection activities:

1. Replace all wear parts affected by use, including gaskets to re-seal the combustion inspection covers that were removed to clean the fireside.

2. Inspect the fireside of the heat exchanger and clean any fouling.

3. Remove the burner and thoroughly wash and clean the mesh. This should be done even if the burner appears to be clean. After washing the burner, reinstall it and use the fan test option to blow dry the burner. DO NOT fire the burner while wet.

4. Replace old igniter, flame rod and gaskets

5. Select the right water treatment to prevent scale. Water side scale is equivalent to having a thin film of insulation between the furnace gases and boiler water. It can drop a boiler's efficiency by as much as 12% - 21%.

6. Re-start the equipment and adjust combustion using a calibrated analyzer. A water tube manometer will be necessary to check for proper draft readings.

7. Inspect electrical connections for corrosion and proper connection.

8. Clean the condensate trap

NOTE: Refer to the manufacturer specific manual for the recommended inspections and maintenance of individual oil boilers before performing annual inspection.

Michael Hirt, Program Head of the Construction Trades Technology at the University of Alaska Fairbanks offers a weeklong oil boiler maintenance workshop and would be able to offer the class in Minto if desired by the community. This class includes hands on training with community boilers, and attendees will be qualified to conduct annual boiler inspection and cleaning services.

Motivation

The action items mentioned in this CEAP are a just a few attainable examples to reduce energy consumption. There are many more and the village is only limited by its imagination and ingenuity.

All it takes is for you to set the ball in motion to make Minto more energy independent and self-sufficient.

PV-Battery Economic Assessment for Minto, AK

Xiangkun Li, Sean Esterly

5/1/2018

Project Overview

- Village would like to reduce dependence on fossil fuels for power generation, space heating, and DHW production
- The Minto Village Council passed a resolution to meet **50%** of utility scale energy demand with renewable energy by **2025**
- This study analyzes the life-cycle economics of installing PV and storage to reduce diesel generation

Scenarios Modeled

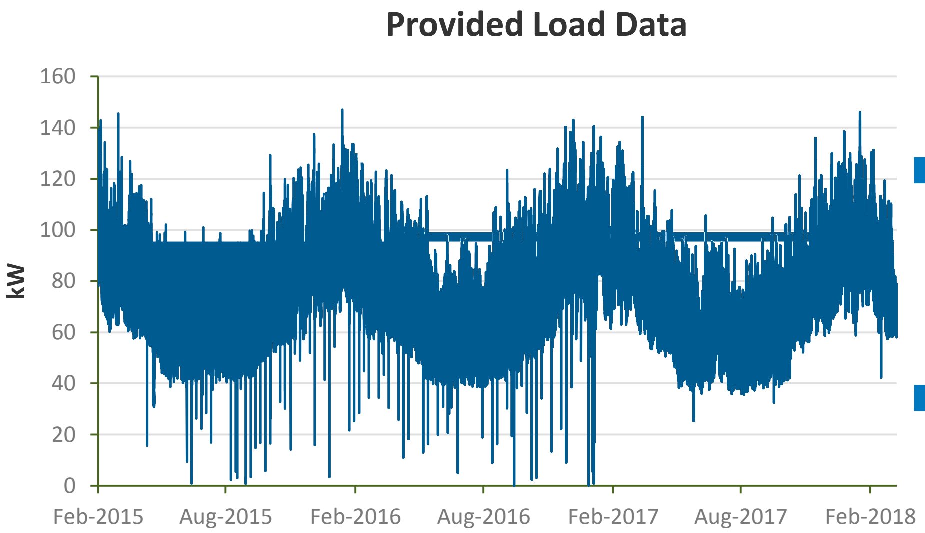
- Analysis objective:
  - Minimize total life-cycle cost (LCC) by selecting the optimal **mix and operation** of diesel generation, PV power, and battery storage

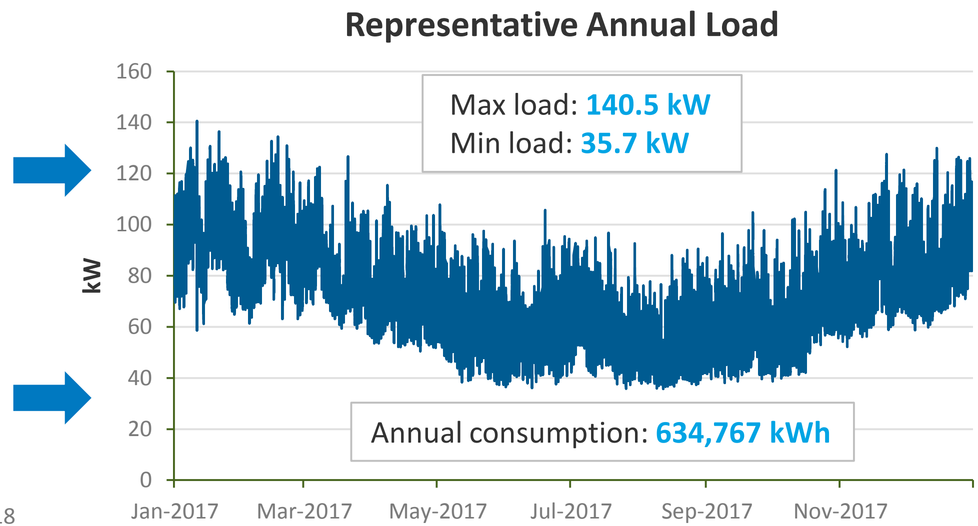
- The economics of the following scenarios are compared:
  - **Base case**: continue to run existing diesel generators
  - **Proposed system case**: optimally size a battery for a proposed 150kW PV system
  - **Fuel reduction case 1**: optimally size a PV and battery system to achieve a **35%** reduction in diesel fuel consumption
  - **Fuel reduction case 2**: optimally size a PV and battery system to achieve a **50%** reduction in diesel fuel consumption

Modeling Assumptions

- Analysis is based on a macro model of village electricity needs and costs moving forward
- Existing utility sunk costs and other fixed overhead costs are not included
- Transactions between the utility and utility customers are not modeled
- Minto is in the process of converting its electrical distribution system from **1 phase** to **3 phase** – the cost of this upgrade and other grid costs associated with enabling high penetration PV integration are analyzed separately and not included in this economic analysis
- The impacts of the **PCE subsidy** are also not modeled. How renewable energy projects impact PCE payments should be further analyzed.

Electric Load Data





- 15-minute load data provided from 2/8/2015 to 3/17/2018; consistent consumption pattern
- Representative annual load profile derived from 2017 measurements with outages removed; missing data was linearly interpolated

Economic Parameters and Costs

Key assumptions	
Ownership model	Direct purchase (utility-owned systems)
Incentives	Not eligible
Analysis period	25 years
Discount rate	3% (real)
Diesel generator cost	$0 (existing)
Installed PV cost	$3/W
PV O&M cost	$0.02/W-DC/year
Battery cost	$1,000/kWh + $1,500/kW
Battery replacement costs	$400/kWh + $500/kW (single replacement in Year 10)

Diesel Generator Modeling

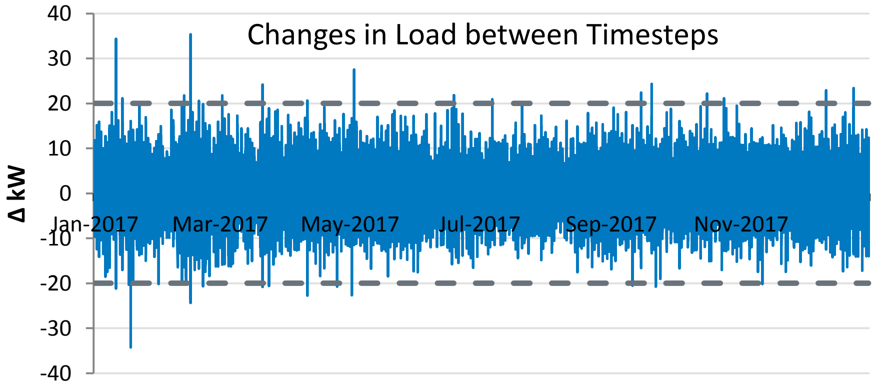
- Minto has 3 generators, but typically only one operates at a time:
- Generator 2 is currently the most utilized, but Generator 1 is modeled in this analysis due to its smaller size to avoid high levels of **underloading**
- Average generation efficiency observed from 2015 to 2017 is **12 kWh/gal**

	Size	Engine Hours 2015	2016	2017
Generator 1	168 kW	54	367	327
Generator 2	229 kW	8252	5724	7600
Generator 3	250 kW	461	2772	600

- The performance characteristics of a generic generator of a comparable size is modeled
- For best practice operation, a minimum turndown of **30%** is assumed
  - Constraint is removed in the base case as demand dips to **20%** loading for parts of the year
- Diesel is allowed to shut off during hybrid operation if reserve requirements are fulfilled

Reserve Requirements

- To ensure reliable operation with intermittent generation and to allow the generator to turn off, the following reserve requirements are modeled:
  - **20kW** for sudden changes in load
  - **50%** of PV generation going to load



- Reserves can be served by **spinning generation**, excess **PV**, or energy stored in the **battery**

Generator O&M Costs

- The following costs do not take into account the impact of PCE subsidies:

O&M costs		Notes
Fuel cost	$3.02/gallon	Average cost of fuel from 2014-2016 PCE reports
Fuel cost escalation rate	1%/year	Based on EIA and University of Alaska Fairbanks estimates
Non-fuel O&M	$0.10/kW-installed/hour of runtime	NREL estimate of generator maintenance costs

PV Modeling

- Modeled using NREL's PVWatts Calculator
- Weather file location: Fairbanks, AK (average capacity factor = 11.3%)
- Assumed unlimited space for PV installations

Technology modeling assumptions	
Array type	Fixed, ground-mount system
Azimuth	180° (south-facing)
Tilt	65°
Annual panel degradation	0.5%
Losses	14%
Useful life	25 years

Battery Modeling

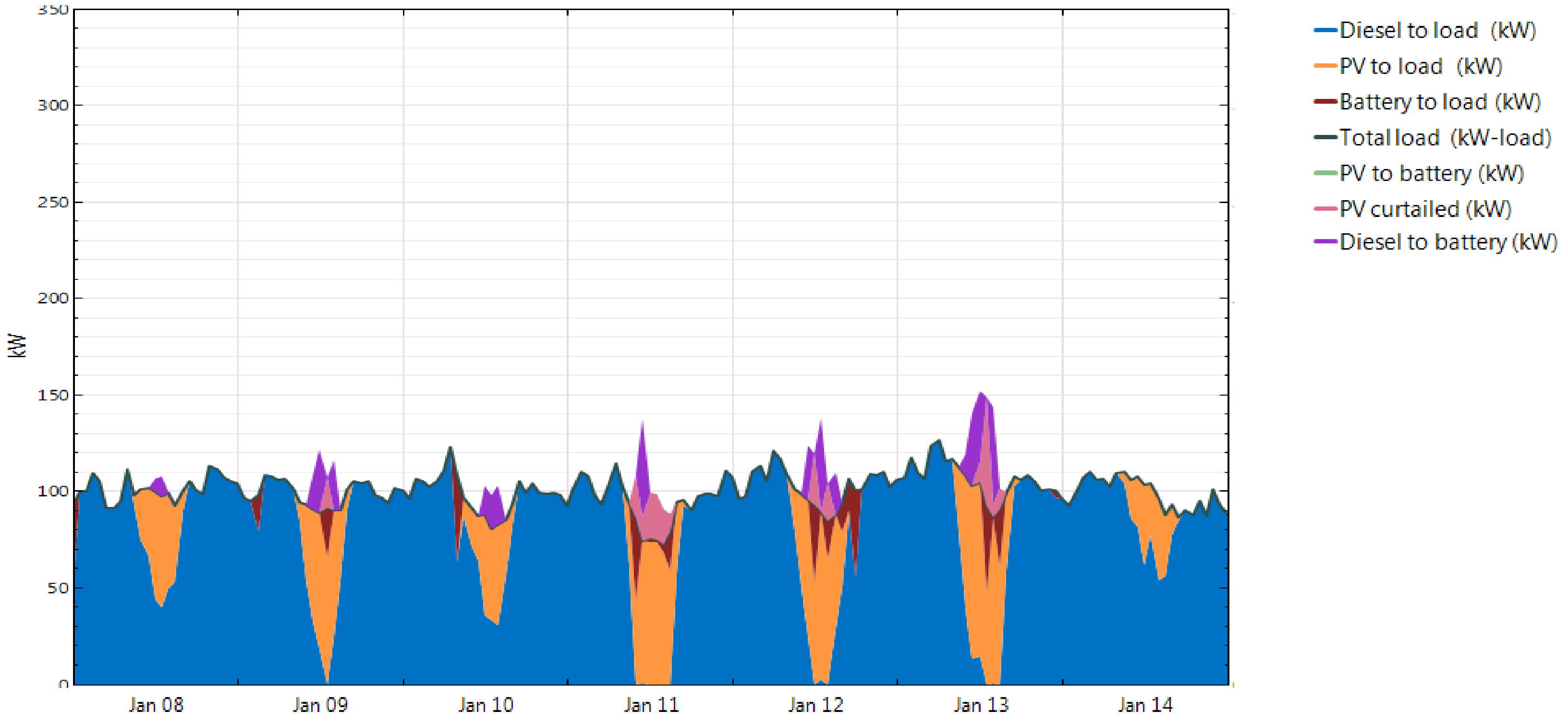
- The battery is modeled as a generic energy storage reservoir, but perfor-mance specifications are based on lithium-ion battery characteristics

Technology modeling assumptions	
AC-AC roundtrip efficiency	90%
Minimum state-of-charge	20%
Useful life	10 years

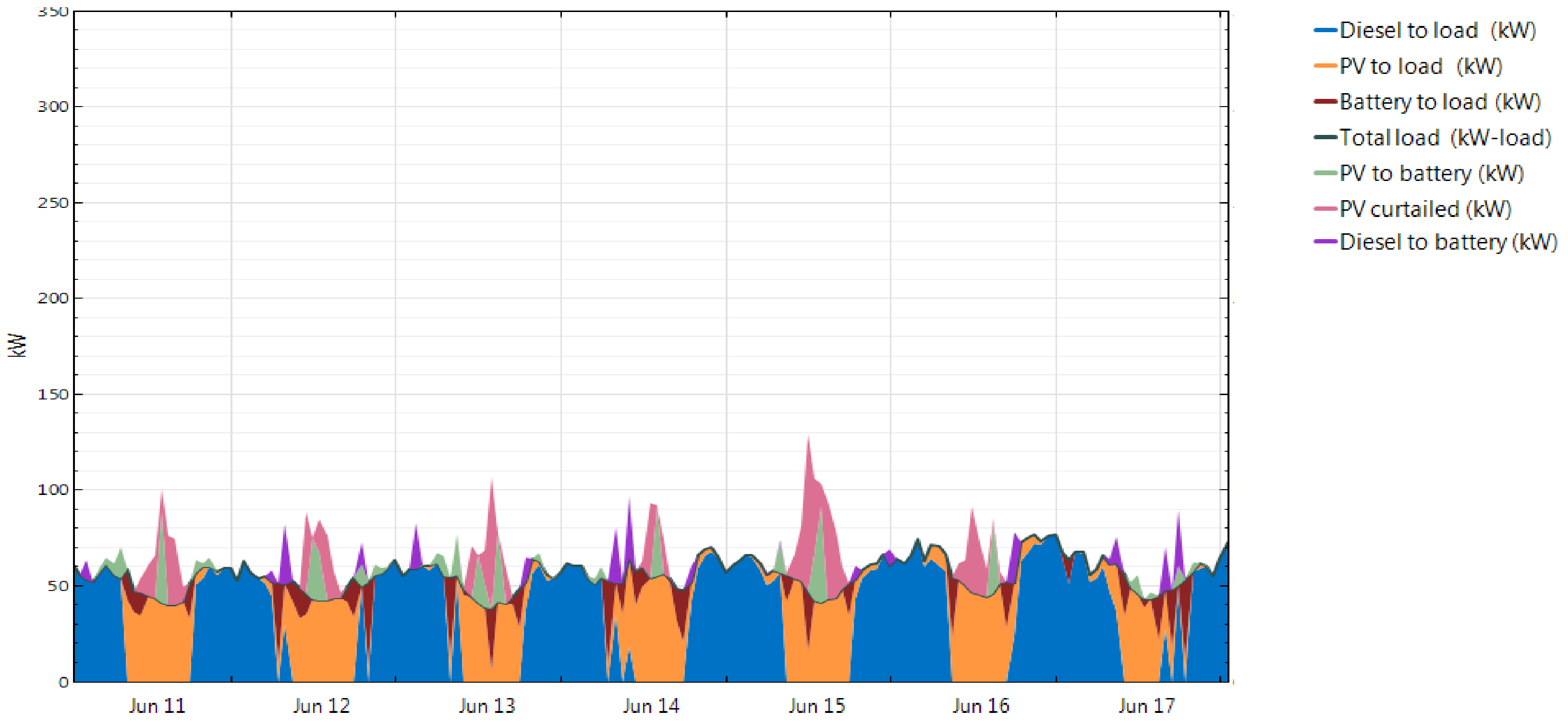
Results

	Diesel Only	Proposed PV Sizing	35% Diesel Reduction	50% Diesel Reduction
Net present value ($)	Base Case	$296,208	$162,748	-$114,462
Total life-cycle cost ($)	$5,026,968	$4,730,760	$4,864,220	$5,141,430
Capital cost ($)	-	$656,206	$1,658,150	$2,756,220
Diesel size (kW)	168	168	168	168
PV size (kW-DC)	-	150	320	465
Battery storage size (kWh)	-	95	455	890
Battery inverter size (kW)	-	45	60	115
Diesel fuel consumed (gallons/year)	41,699	34,079	27,104	20,849
Diesel-off hours (hrs/year)	0	1895	3657	5372
Total fuel reduction (%)	-	18%	35%	50%
PV to electric load (%)	-	75.2%	51.8%	39.5%
PV to battery (%)	-	8.9%	25.0%	37.2%
PV curtailed (%)	-	15.9%	23.2%	23.3%
Diesel to battery (%)	-	2.72%	3.91%	7.63%

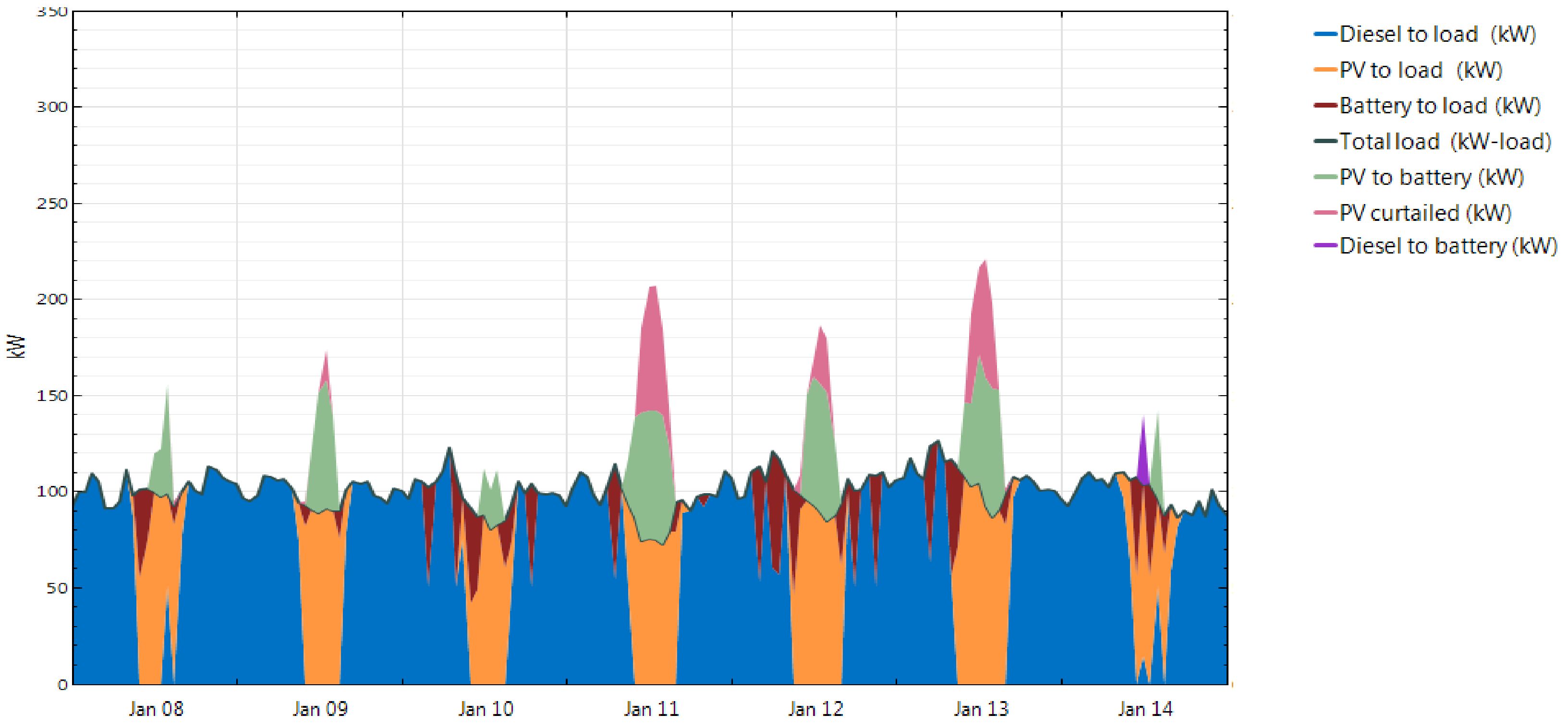
Example Winter Dispatch: 150 kW PV System



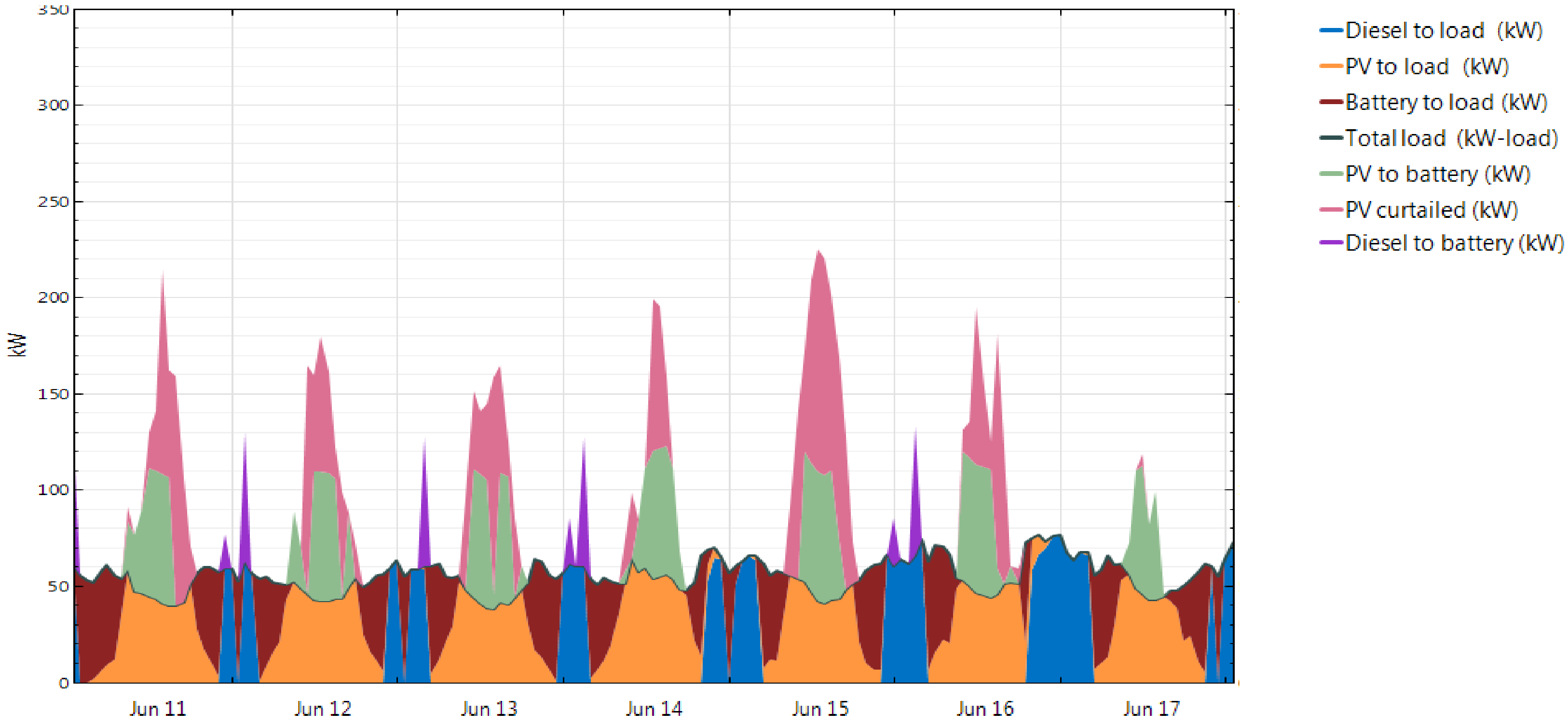
Example Summer Dispatch: 150kW PV System



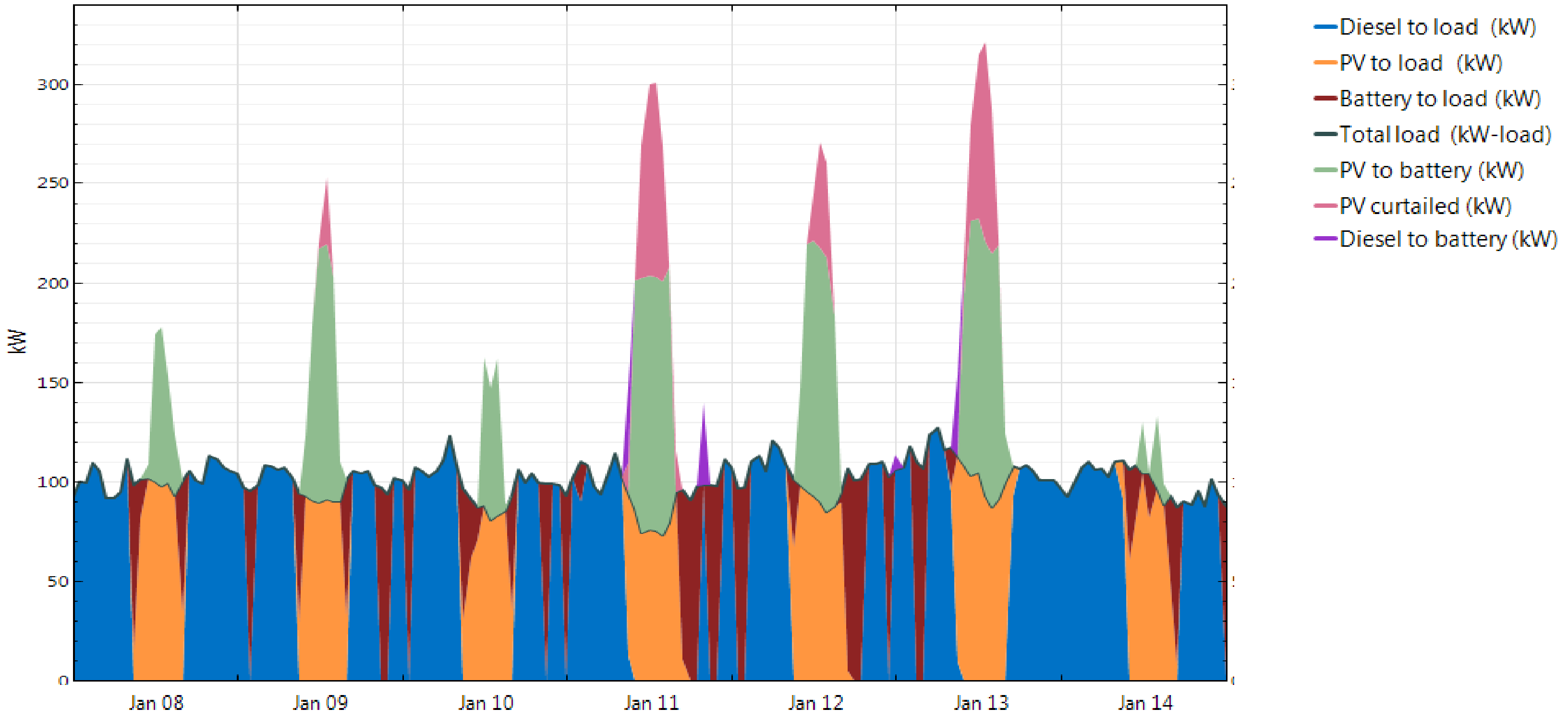
Example Winter Dispatch: 35% Fuel Reduction



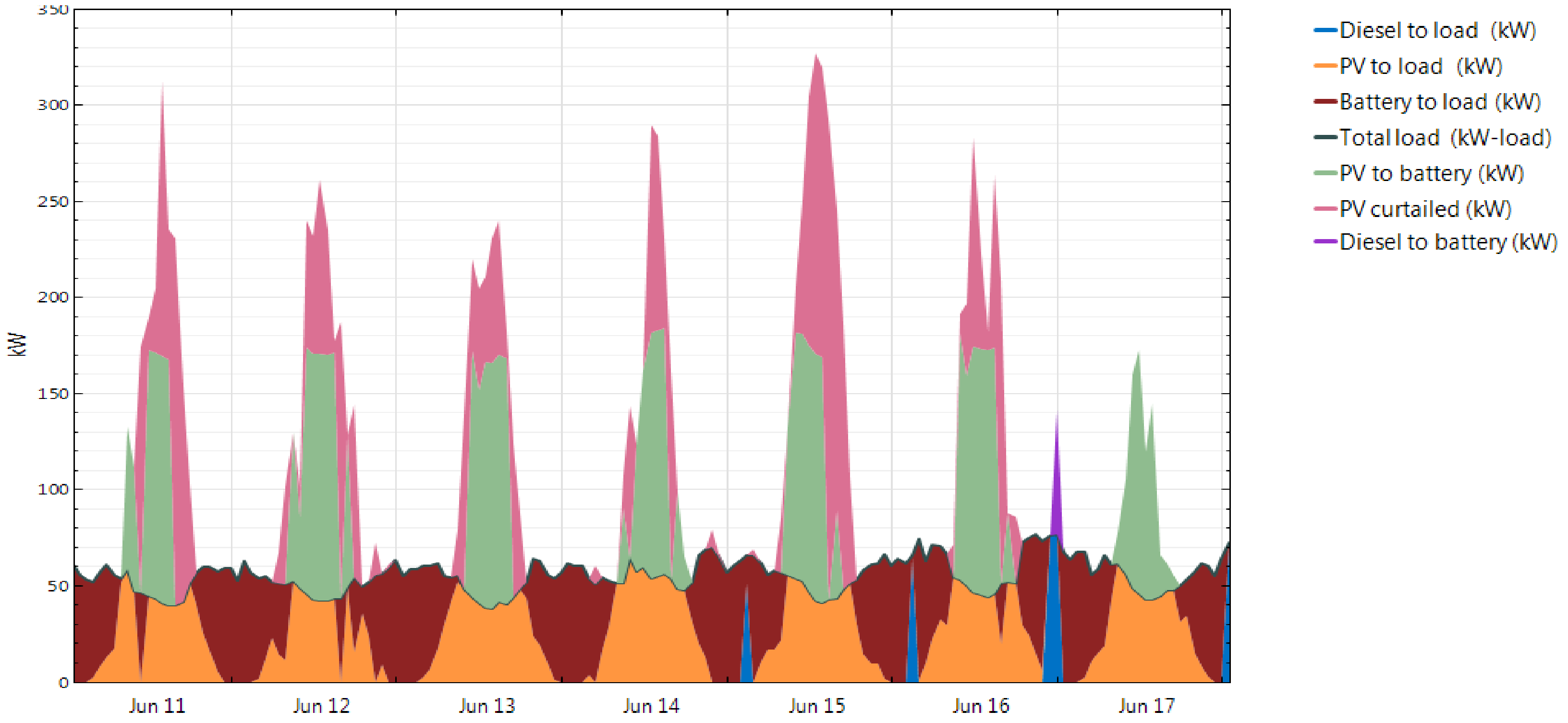
Example Summer Dispatch: 35% Fuel Reduction



Example Winter Dispatch: 50% Fuel Reduction



Example Summer Dispatch: 50% Fuel Reduction



Interpreting Results

- Model solutions are indicative of the system types and sizes and their impact on fuel consumption and operating costs. However the model does not generate the final design; it suggests a starting point:
  - Detailed electrical engineering studies may be required to determine whether additional electrical system upgrades are required and the types of additional equipment that are needed to manage grid stability
  - Vendors may have cost structures different than what was assumed in the model
  - Vendors may not have equipment available in the optimal sizes described here (e.g. a battery vendor may only offer power control systems in 100kW size increments while the solution from the model suggests a 45kW size is optimal)

Conclusions

- Results show the net present value (NPV) of different solar+storage projects in Minto, AK
- A positive NPV is seen for systems sized up to a **35%** reduction in diesel fuel consumption
  - These systems may be life-cycle cost effective if the required grid and other hardware upgrade costs to implement the design are below the calculated NPV
- A solar+storage system sized to achieve the Minto Village Council's goal of **50%** diesel reduction is currently not cost-effective
  - Requires an increase of **2.3%** in total life-cycle costs over the analysis period compared to base case diesel-only operation plus any additional system upgrade costs
- Large capital investments are required to significantly reduce diesel fuel consumption

Disclaimer

- This analysis was conducted using the NREL REopt Model [http://reopt.nrel.gov/]. REopt is a techno-economic decision support model that identifies the cost-optimal set of energy technologies and dispatch strategies to meet site energy requirements at minimum lifecycle cost, based on physical characteristics of the site and assumptions regarding energy technology costs and electricity and fuel prices. The analysis relies on site information provided to NREL by the Minto Village Council that has not been validated by NREL.

- The purpose of the study is to analyze and compare the economics of different PV and battery systems sized to fulfill Minto Village renewable energy goals using a mixed integer linear program. These results should be treated as an initial step, not the final solution. The results are not intended to be the sole basis of investment decisions but rather are intended to inform decision-making that includes multiple other factors not included in the modeling exercise.

- Actual project development would require more detailed assessment that could include: on-site assessments to identify appropriate project sites, including structural and land area review; verification of on-site RE resource through on-site resource measurements; environmental and endangered species review; and cultural and historic resources review.

- The data, results, and interpretations presented in this document have not been reviewed by technical experts outside NREL or the Minto Village Council.

- This analysis was conducted for internal use by the Minto Village Council only and is not intended for public use. The data, results, and interpretations presented in this document should not be disseminated, quoted, or cited.

Thank you

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