Tanana Chiefs Conference

Priority Climate Action Plan

Native Village of Tetlin

Tetlin, AK

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Appendix A - Alaska Energy Authority's Power Cost Equalization Program Statistical Report for Tetlin (FY2022)

Acronyms and Abbreviations

AEA	Alaska Energy Authority
AML	Alaska Municipal League
ANTHC	Alaska Native Tribal Health Consortium
AP&T	Alaska Power & Telephone Company
ARIS	Alaska Retrofit Information System
BESS	Battery Energy Storage System
CAPEX	Capital Expenditures
CCAP	Comprehensive Climate Action Plan
CO_2	Carbon Dioxide
CPRG	Climate Pollution Reduction Grant
CSEAP	Comprehensive Sustainable Energy Action Plan
DC	Direct Current
DOE	Department of Energy
DOT	Department of Transportation
EIR	Environmental Impact Report
EPA	Environmental Protection Agency
EV	Electric Vehicle
GHG	Greenhouse Gas Inventory
HUD	Housing and Urban Development
IPP	Independent Power Producer
kW	Kilowatt
kWh	Kilowatt Hour
LED	Light-Emitting Diode

Li	Lithium
LIDAR	Light Detection and Ranging
MET	Meteorological Tower
MPH	Miles Per Hour
O&M	Operational Expenditures
OPEX	Operational Expenditures
PCAP	Priority Climate Action Plan
PCE	Power Cost Equalization
PV	Photovoltaic
RCA	Regulatory Commission of Alaska
TCC	Tanana Chiefs Conference
TVC	Tetlin Village Council
UAF	University of Alaska Fairbanks
U.S.	United States
VPSO	Village Public Safety Officer
WTP	Water Treatment Plant

Executive Summary

This Priority Climate Action Plan (PCAP) is designed for the Native Village of Tetlin, a rural and predominantly Alaska Native community of approximately 106 residents in Interior Alaska. This PCAP identifies sources of greenhouse gas (GHG) emission in the community and proposes a diverse set of strategies for lowering them through an iterative stakeholder engagement process.

Several Energy Focus Areas were identified for Interior Alaska, and specifically, for Tetlin. GHG production levels and energy costs for Tetlin were first evaluated by reviewing data from the Alaska Energy Authority's (AEA's) Power Cost Equalization (PCE) Program Statistical Report (AEA 2023) and a GHG Emission Inventory Tool (Constellation Energy, 2024). Next, the impact of future renewable energy systems in the community was evaluated using modeled reductions in generator-produced power and fuel costs with HOMER Pro software (UL Solutions) under a scenario in which 20% of a representative community's energy infrastructure would be converted to the most likely renewable energy system: solar photovoltaic (PV) with battery energy storage system (BESS). Finally, recommendations were provided for specific strategies for Tetlin to become more energy efficient with the aim of lowering GHG emissions and operational costs for the community.

Based on the available data, diesel was the primary energy source of power and GHG emissions in Tetlin in 2022 (AEA 2023). Tetlin's 50 residential customers, 5 community facility customers, and 10 other customers required a portion of the 10,513,000 kWh of diesel-generated power and 0 kWh of non-diesel-generated power from the Alaska Power & Telephone Company (AP&T) facility in Tok which also provides power to the communities of Tok, Tanacross, and Dot Lake. A total of 417,783 total kWh was sold to Tetlin customers requiring approximately 4% of the powerhouse consumption of the 724,329 gallons of diesel fuel (approximately 28,973.16 gallons) at the AP&T facility. Assuming that 22.38 lbs CO_2 are produced per gallon of diesel consumed, it can be determined that Tetlin accounted for approximately 648,419 lbs CO_2 produced by the AP&T facility in FY2022.

A total of 724,329 gallons of fuel were consumed at the AP&T facility (about 28,973.16 by Tetlin customers) at a cost of $2,166,028 ($2.99 per gallon; $86,629.75 for Tetlin customers). The average fuel cost per kWh in Tetlin in 2022 was $0.25. The annual non-fuel expenses associated with power generation at the AP&T facility totaled $1,890,212 in FY22, resulting in an additional cost of $0.22 per kWh sold. Thus, the combined fuel and non-fuel expenses at the AP&T facility required to produce power for Tetlin were $0.47 per kWh sold in FY22. The last reported electric rate paid by customers was $0.57 per kWh. Tetlin's electric rate is over 3.5 times the national average of $0.16 per kWh. Tetlin was PCE eligible for 51.5% of its total kWh sold in Fiscal Year (FY) 2022 resulting in PCE payments to Tetlin in the amount of $62,161 to offset its high energy costs. The average annual subsidized PCE payment per eligible customer was $1,130 (AEA 2023).

Constellation Energy (2024) emission inventory reporting for Tetlin indicated that approximately 24% of GHG emissions (85.24MT) in Tetlin come from the residential sector, with the highest amount of GHGs coming from burning fuel oil (66.00 MT) and wood (19.24 MT) in stationary locations. Alternatively, 69% of stationary emissions come from the commercial and industrial sectors, with the highest amount of GHGs coming from burning fuel oil (228.27 MT), propane (17.43 MT) and wood (0.63 MT). Approximately 7**%** of the community's GHG emissions (26.43 MT) come from the transportation sector, with aviation gasoline (26.43 MT) being the largest GHG contributor. In Tetlin, on-road emissions produce approximately 0MT of GHGs, while non-road emissions produce about 26.43 MT of GHGs. Total annual electricity used in Tetlin equates to approximately 418 MWh.

Using the Constellation Emission Inventory Tool and HOMER Pro modeling software for a representative Interior Alaska community, it was projected that a solar PV + BESS array under an optimized design would result in substantial reductions in diesel fuel consumption, CO_2 emission, and operational costs.

Following a review of this information and responses to a Community Survey issued to Tetlin by Tanana Chiefs Conference (TCC), preferred options for cleaner and lower cost energy in Tetlin may be:

- Tok – Delta High Voltage Transmission Line Intertie
- Solar PV + BESS array (may reduce fuel consumption and CO_2 production by up to 20%);
- Weatherization of residences, tribal buildings, and commercial buildings;
- Biomass energy systems (e.g., wood chip boilers); and
- Wind energy study.

1 Introduction

1.1 Purpose of a Priority Climate Action Plan (PCAP)

The purpose of a Priority Climate Action Plan (PCAP) is to assist Tribes and Territories in identifying sources of greenhouse gas (GHG) emissions in their communities and developing diverse and appropriate strategies for reducing them through an iterative stakeholder engagement process. PCAPs are designed as narrative reports that include a focused list of near-term, high-priority, and implementation-ready measures to reduce GHG pollution and an analysis of GHG emissions reductions. A targeted result of PCAP development is to inform the more detailed Comprehensive Climate Action Plan (CCAP). CCAPs are narrative reports that provide an overview of a Tribe or Territory's significant GHG sources / sinks and sectors, establish near-term and long-term GHG emission reduction goals, and identify strategies or measures that will address the highest priority sectors to achieve those goals.

PCAPs may include a GHG inventory, or list of emission sources and sinks, and the associated emissions quantified using standard methods. The PCAP's GHG inventory is a simplified version of a forthcoming comprehensive or detailed GHG inventory that will be developed in the CCAP where multiple sectors will be evaluated, including industry, electricity generation/use, transportation, commercial and residential buildings, agriculture, natural and working lands, and waste and materials management.

The United States (U.S.) Environmental Protection Agency (EPA) has funded this PCAP development effort through a Climate Pollution Reduction Grant (CPRG)[1] with the goals of:

1. Improving the understanding of current and future GHG emissions;
2. Identifying priority strategies for reducing emissions and documenting the benefits; and
3. Engaging a variety of stakeholders in an emissions reduction planning process.

The EPA encourages Tribes to collaborate with each other and with other entities (states, municipalities, etc.), to explore opportunities to leverage other federal funds, and to prioritize durable and replicable GHG reduction measures.

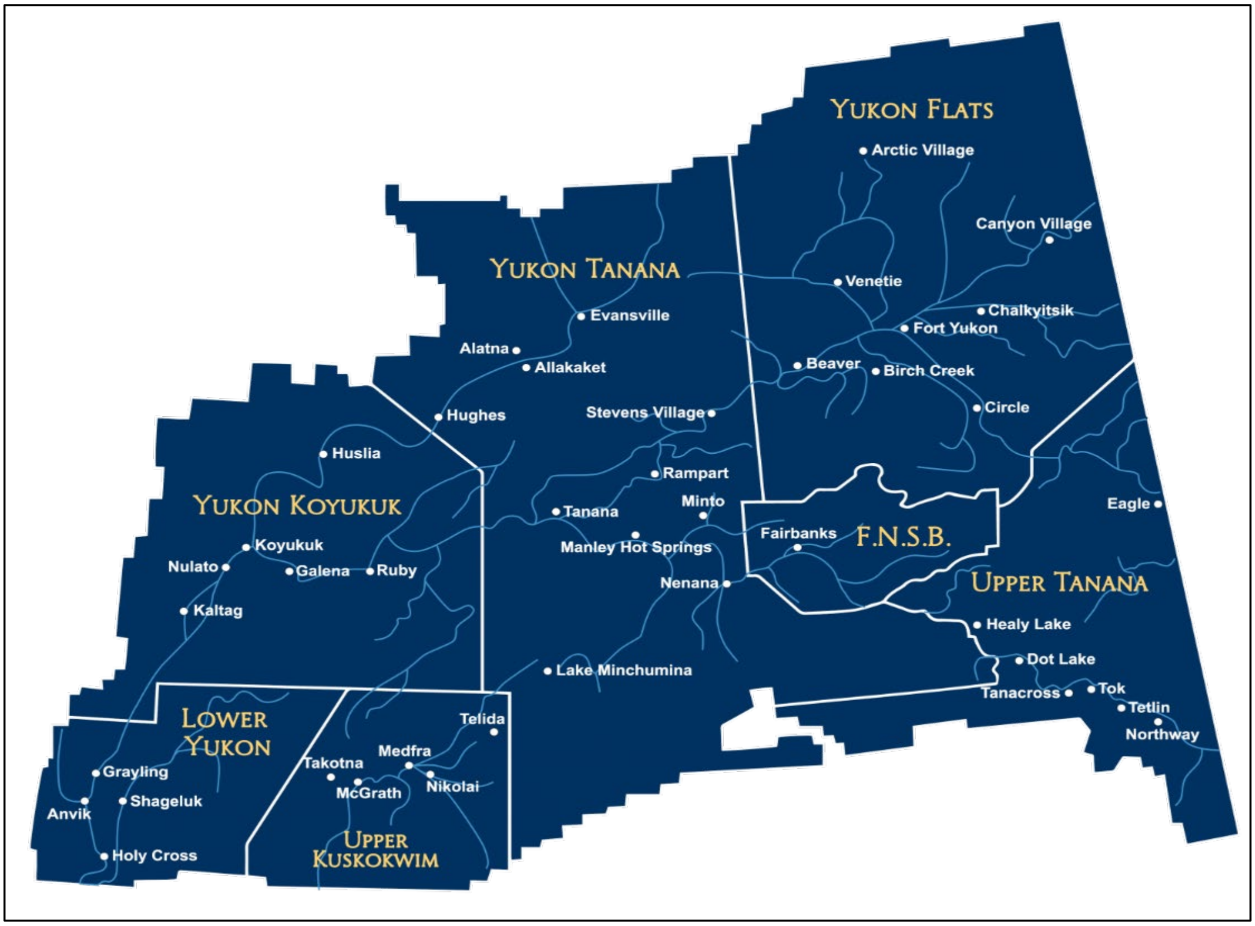
1.2 Tanana Chiefs Conference's Climate Pollution Reduction Grant

Tanana Chiefs Conference (TCC) is a tribal consortium made up of 42 members, including 37 federally recognized tribes. TCC was awarded a CPRG from the U.S. EPA to develop and implement ambitious plans for reducing greenhouse gas emissions and other harmful air pollution. TCC provides a unified voice in advancing sovereign tribal governments through the promotion of physical and mental wellness, education, socioeconomic development, and culture of the Interior Alaska Native people. TCC's region covers an area of 235,000 square

[1] Climate Pollution Reduction Grants | US EPA were authorized under Sec. 60114 of the Inflation Reduction Act.

miles, which is equal to about 37% of the entire state, and just slightly smaller than the state of Texas. TCC exists as an Alaska Native non-profit corporation charged with advancing Tribal self-determination and enhancing regional Native unity. TCC works toward meeting the needs of Tribal members and beneficiaries throughout its region in areas of health and social service. TCC also administers programs and services in healthcare, tribal development, natural resource management, public safety, community planning, transportation, infrastructure and energy.

Figure 1. Tanana Chiefs Conference Communities



The awardee has devised a **CPRG Leadership Team** to administer this award and execute its initial phases. This team includes:

- Tanana Chiefs Conference (TCC) – Awardee and Grant Administrator
  - Dave Messier – Infrastructure Director
  - Jason Paskvan – Project Manager and Community Liaison
  - Eddie Dellamary – Administrative and Project Support

- TCC Cooperators
  - ANTHC – data analysis and GHG emission estimates
  - Alaska Municipal League (AML) / Constellation – Emissions modeling, incorporating PCE, ARIS, and other state data to provide reliable inventory estimates for communities, emission inventory data, other inventories, data projections.
- TCC Subcontractors
  - Axiom Environmental – PCAP Report Development, data review, and community recommendations for reducing GHGs and alternative energies.

TCC will work with EPA Region 10 Staff throughout this process, including:

- Rebecca Derr (EPA Region 10 MPH, Tribal Project Officer and CPRG Planning Officer)
- Kat Compton (EPA Region 10 Climate Coordinator)

1.3 Approach to Developing the PCAP

The CPRG Leadership Team's approach to developing this PCAP includes:

- Identifying and engaging key stakeholders;
- Understanding the GHG emissions inventory;
- Establishing GHG reduction goals;
- Identifying measures to reduce GHG emissions;
- Prioritizing and selecting GHG reduction measures; and
- Estimating potential GHG reduction measure impacts.

1.4 Scope of this PCAP: The Community of Tetlin

Tetlin, Alaska is a traditional Upper Tanana Athabascan village that is home to approximately 106 people in 50 households. Tetlin is located along the Tetlin River between Tetlin Lake and the Tanana River, 20 miles southeast of Tok. It lies in the Tetlin National Wildlife Refuge. The village is connected by road to the Alaska Highway.

The area experiences a cold, continental climate with extreme temperature differences. Temperatures generally range from well below 0°F in winter to the lower 70s °F in summer. The lowest recorded temperature in Tetlin is -71°F, and the highest recorded temperature is 99°F. The average low temperature during January is -32 °F. Ice fog is common during the winter in the valley. Average annual precipitation is 10 inches, with 35 inches of snowfall.

Tetlin is connected to the primary Alaska road system and shares a power grid with neighboring communities. Power is generated in Tok at a diesel power plant operated by The Alaska Power & Telephone Company (AP&T). Diesel generators distribute electricity through underground power lines that run along Tetlin Road. Tetlin does not have any bulk fuel storage tanks. The largest tanks in the community are at the Washeteria and the school. These tanks are periodically filled from a company based out of Tok. Tetlin's primary source of heat is wood.

Tetlin's Tribal population is below poverty level[2], and the U.S. Department of Transportation (DOT) classifies Tetlin as a Historically Disadvantaged Community, existing in an Area of Persistent Poverty[3]. Approximately 67% of Tetlin's Tribal residents are classified either low or middle income by the U.S. Department of Housing and Urban Development (HUD)[4].

Figure 2. Tetlin, Alaska

Following release of this PCAP at the end of 1Q 2024, the CPRG Leadership team will next develop a CCAP in partnership with the Tribe and the broader community, continuing communication with the Tribe as it moves towards decision-making around clean energy projects. The more detailed CCAP is expected to be completed around 4Q 2026.

2 Tribal Considerations for PCAPs

The evaluation of clean energy alternatives in remote, Tribal communities requires specific considerations for PCAPs, including:

- Geographic constraints
  - A high-latitude environment and the low light of winter can limit year-round efficiency of solar arrays;
  - Areas of degrading permafrost can be challenging from a geotechnical standpoint. If not addressed carefully, permafrost settlement or frost jacking could cause solar

[2] EJScreen (epa.gov)

[3] https://screeningtool.geoplatform.gov/en/#3/33.47/-97.5

[4] https://www.huduser.gov/portal/icdbg2022/home.html

panels, wind turbines, or other infrastructure to experience differential movement, affecting maintenance costs and efficiencies;

- Placement of solar panels is important with proximity to hills or mountains, which can block sunlight in shoulder seasons;
- Interior communities may not have sufficient wind for dual alternative energy systems;
- Wood chip boilers / biofuels may be efficient systems given availability of local timber;
- For river energy, periods of low flow are common for long winters, and river debris, ice dams, and other issues makes use of mainstem rivers challenging;
- Hydrogen may not be practicable at this time;
- The remote nature of communities can make some projects cost-prohibitive and can limit timely maintenance of solar or wind systems;
- Cost-Benefit Analyses (CBAs) for alternative energy investments may rarely work favorably for small, rural communities;
- Weatherization is likely to improve the efficiency of existing systems;
- Generators, switch gear, and grid components may be old or outdated, and retrofitting, refurbishing, or rewiring may balance loads to conserve fuel;
- Utilizing battery energy storage systems (BESS) allows existing generators to run optimally and avoid excess / waste power generation;
- Limited or inconsistent data and non-standardized data limit decision making.

2.1 Energy Focus Areas

This PCAP identifies several Energy Focus Areas for consideration with respect to Interior Alaska, and specifically, for Tetlin. These are described in detail, below.

2.1.1 Solar

Solar projects harness energy from sunlight, channeling the generated electricity into long-term BESS or directly into a utility grid. The incorporation of solar into microgrids extends the accessibility of renewable energy's financial and environmental advantages to a broader population. Solar's appeal lies in the prospect of achieving energy independence, as well as the opportunity to become an independent power producer (IPP). Communities or individuals that integrate solar panels with battery backup systems facilitate the production, storage, and utilization of their own electricity. This significantly diminishes dependence on externally generated power, contributing to a more sustainable and resilient energy system.

The University of Alaska Fairbanks (UAF) explores the integration of solar into microgrids, emphasizing its environmental and economic benefits. A microgrid controller's "diesels off" function facilitates automatic coordination between solar power, energy storage, and diesel plants, optimizing the use of solar panels or other clean energy sources. A real-world example of this is the community of Shungnak in Alaska, which lies north of Tetlin and demonstrates a reduced reliance on diesel power through the implementation of a 225-kW solar array with a 384-kWh battery system (DOE 2024). For several months in summer, the community can switch off diesel-generated power and run solely on solar. This is not an achievable goal in winter, however, because of the low light and because generators are kept warm by their own rejected heat; if they are shut off for a significant amount of time, it may create challenges for re-starting or replacing that heat. In Tetlin's case, this could be either an electric boiler, or a small diesel boiler to inject heat into the generator coolant loop.

Alaska presents a unique advantage for solar systems despite the misconception that limited sunlight diminishes their viability. While Alaska's winter months experience reduced sunlight, northern latitudes benefit from extended daylight with prolonged sunrises and sunsets. Although the nature of solar energy in a strongly seasonal environment poses some challenges, Alaska's solar potential avoids the use of mobile or moving parts. Solar energy offers reliability, minimal environmental impact, and a steady, evenly distributed presence. The declining cost of solar energy harvesting coupled with the technology's simplicity and low maintenance positions solar power as a viable and sustainable energy source in Alaska (UAF 2022).

Due to the potential for the presence of discontinuous permafrost in Interior Alaska, mounting strategies for any solar installation should be carefully considered during the design process. Common approaches to installation involve either using an insulated, ballasted racking system that minimally disturbs the soil, or using helical piles driven into the ground past the active permafrost layer.

Solar power is considered to be one of the most viable options for rural Alaska. Solar power systems are modular and can be easily scaled to meet the specific energy demands of remote Alaska communities. Solar installations can be adapted to various scales for residential, commercial, or community applications. Solar photovoltaic (PV) systems have minimal moving parts, resulting in lower operational and maintenance costs compared to traditional power generation. Once installed, solar panels can operate with relatively little maintenance. Many remote areas in Alaska currently rely on diesel generators for power, which emit GHGs and can be expensive (AEA 2023). Solar power provides an alternative that helps to reduce a community's dependence on fossil fuels and mitigates carbon emissions.

Solar photovoltaic (PV) technology is a proven means of electrical power production that is rapidly now being pursued in rural Alaska through federal funding to offset initial capital costs. Solar PV has been effective in charging battery storage systems in spring due to the longer days combined with increased surface albedo from snow cover on the ground.

Some northern communities have identified airports and airstrips as ideal locations for placement of solar panels because the PVs could take advantage of long, cleared upland areas that are generally south facing. However, a deterrent to this approach is that the Alaska Department of Transportation & Public Facilities (ADOT&PF) must allow construction and maintenance over the lands that it manages for aviation purposes, and the cost of authorized land use could be prohibitive without statutory changes. Additionally, if a community's airport or airstrip is a long distance from town, the cost of connecting solar systems to existing utility lines could be prohibitive. Tetlin's airstrip is less than a mile from town, so the airstrip may be a preferential location for a solar array.

Tetlin's power is generated in Tok and is transferred to Tetlin via underground cables. As of 2020 Tetlin had no plans to operate power generation on their own. There have been no upgrades to the utility since 2010 when Alaska Power & Telephone Company got a grant to put in the tie-in line from Tok to Tetlin. Tetlin does hope to research viable alternatives to reduce the cost and consumption of energy.

2.1.2 Wind

Wind power is a renewable energy source harnessed from the kinetic energy of air currents. Wind energy is converted to electrical power through wind turbines, which consist of small to large blades attached to a hub that spins as the wind blows. The kinetic energy from the rotating blades is converted to electrical energy by a generator, although the amount of energy generated depends on several factors, such as wind speed and direction, turbine efficiency, and the density of air. Thus, location of wind facilities is a crucial consideration for installations.

As the technology behind wind power advances, innovative turbine designs and greater efficiency are enhancing its feasibility and competitiveness. In remote Alaska communities, where access to conventional power infrastructure is limited, wind power may be a viable and sustainable solution to meet the energy needs of isolated communities. Small-scale wind turbines can sometimes be installed at strategic locations to generate electricity locally, thus reducing reliance on diesel generators and lowering overall power production costs. The intermittent nature of wind energy is typically complemented by energy storage solutions such as batteries, ensuring a consistent power supply even during periods of low wind.

Many coastal areas of Alaska are gravitating towards wind power options, but for Interior Alaska, greater certainty around wind speed, direction, and magnitude are necessary to determine whether an investment is worthwhile. While there are installations around Alaska, wind turbines come with some operational and maintenance challenges that may be more difficult to address than solar, which has no moving parts. One advantage of wind power over solar, however, is the generally greater availability of wind as a resource during winter when community loads are highest. Like solar, capital costs of wind can be high, and include design, permitting, transportation, and installation. Permitting wind projects may be a more lengthy process than solar projects due to the potential impacts to avian wildlife and impacts to visual aesthetics.

The high initial capital cost can typically only be recovered in a moderate amount of time if there is a strong and reliable wind resource; however, if capital costs are offset by grants, they can be part of a community's portfolio as an IPP.

Tetlin currently does not have plans to explore wind power as a renewable resource.

The high capital cost of designing, mobilizing, constructing, and connecting a wind project in Tetlin is not likely to recover the capital cost in a short or moderate time frame, due to having only a Class 2 wind resource. Furthermore, integrating wind would require upgrades to the electrical grid.

Because of the marginal wind resource in Tetlin, and the higher capital cost associated with wind, further study is required before pursuing a wind project. There is also hesitancy around wind for Interior Alaska communities like Tetlin because of the number of moving parts that must continue operating at very cold temperatures. Should Tetlin decide to pursue wind energy their next step would be to install a LIDAR unit at the potential wind site to measure and collect data for at least one year. A future wind project could benefit from power grid upgrades if they were previously performed to allow the integration of solar by reducing the capital cost of the wind project.

Notably, in 2016, AP&T won a grant to build a 1.8 MW wind farm located in a Class 4 wind area that would help the communities of Tok, Tetlin, Tanacross and Dot Lake by providing a locally available source of cleaner, more affordable renewable energy. The project was estimated to offset over a quarter million gallons of diesel fuel per year, with annual carbon savings of more than 66,650 metric tons.[5]

2.1.3 Biofuels and Biomass Systems

Biofuels and Biomass Systems are a category of renewable energy derived from organic materials. These fuels are produced through various processes that convert biomass, such as crops, crop residues, wood, and algae, into liquid or gaseous forms that can be used for transportation and energy generation. Biofuels are considered a sustainable energy source because the CO_2 emitted during their combustion is roughly equivalent to the amount absorbed by the plants or algae used in these systems during their growth. This creates a closed carbon cycle that doesn't contribute to a net increase in GHGs.

In Alaska, biofuels and biomass systems are gaining attention as a potential solution to address the unique energy challenges faced by this remote and expansive state. Their use in Alaska primarily focuses on energy derived from woody biomass, such as timber and forest residues, as well as organic waste materials from agricultural and forestry activities. One notable example is the potential use of wood pellets or chips for heating in residential and commercial buildings, reducing the reliance on traditional heating fuels like diesel or heating oil.

Alaska's vast forests and abundant biomass resources make it well-suited for exploring biofuel applications. Alaska has been involved in initiatives to promote sustainable bioenergy production, with a focus on utilizing local resources to enhance energy security and reduce greenhouse gas emissions.

[5] https://www.power-grid.com/renewable-energy/alaska-power-telephone-wins-grant-to-build-wind-farm/#gref

While biofuels and biomass systems are not yet as widely adopted in Alaska as in some other regions, ongoing research and pilot projects aim to explore and develop bioenergy solutions that align with the state's commitment to sustainable and renewable energy sources. As technology advances and the economic feasibility of biofuel production improves, Alaska may increasingly incorporate biofuels into its diverse energy portfolio to address the unique challenges of its remote communities. Ethanol and biodiesel are two common types of biofuels globally, but these are unlikely to gain wide popularity in remote Alaska.

Concerns about land-use change, competition with food production, and the overall environmental impacts of biofuel production methods highlights the importance of sustainable practices and continual research to ensure that biofuels contribute positively to the country's transition to a more sustainable and low-carbon energy future.

In 2011 a Biomass Energy Project in Tetlin had a state funding request of $200,000 approved. The Tetlin Village Council (TVC) worked with Gateway School District to replicate a biomass heater/electrical generator plant similar to, but smaller than the project completed at Tok School. The project was slated to use thousands of cords of standing dead wood in the surrounding areas from a past forest fire. The plant was designed to produce 80 to 100 KWH of electricity and 2 to 3 million BTUs of condensate heat. The heat and electricity was to be used in public buildings and sold to the Alaska Gateway School District to heat and power the Tetlin School (Tetlin - Biomass Energy Project, 2011). As of 2020, the project was not operating.

Tetlin is surrounded by forest, which provides an excellent biomass resource. A wildfire left thousands of cords of standing dead wood near Tetlin. Residents harvest their own wood or buy from local vendors for heat in their homes. Clearly, the resource is able to support additional biomass projects. Additional wood harvest could also help to improve forest health and reduce forest fire hazard.

The 2011 biomass project is not currently operating for a number of reasons. Getting this project back on line could help reduce energy costs for the public buildings and the school.

2.1.4 Electric Grid Capabilities and Upgrades

Electric grids can help to interface with and incorporate cleaner, renewable energy sources. Advanced grid technologies, such as smart grids, enable better management and integration of fluctuating renewable energy generation.

Upgrading and optimizing a community's transmission and distribution infrastructure enhances the efficiency of the electric grid. This reduces energy losses during electricity transport and ensures that power generated from renewable sources can be efficiently delivered to end-users, minimizing the need for additional generation capacity and associated GHG emissions. Energy storage solutions, such as batteries, may also help address renewable system intermittency (e.g. periods of low light for solar systems, periods of low wind for wind energy systems).

There have been no upgrades made to the energy grid since the tie-in line from Tok was installed in 2010. Should Tetlin explore alternative sources of electrical generation upgrades would be needed to accommodate the new projects.

2.1.5 Port and Airport Electrification

Port and airport electrification is a strategy aimed at reducing carbon emissions associated with major transportation centers that include airports, seaports, and terminals. The transition from traditional fossil fuel-powered systems to electric power at these centers offers several potential environmental and economic benefits. Success depends on factors such as the availability of reliable electric infrastructure, the integration of renewable energy sources, and collaboration between stakeholders including port authorities, shipping companies, and energy providers.

In remote Alaska communities, however, ports may exist only as a rudimentary dock; airports may exist only as a lighted airstrip with weather station and storage shed. Incorporating renewable energy, developing microgrids, installing charging infrastructure, and fostering community collaboration are integral components of successful electrification initiatives in such challenging environments. If power and lighting needs at airstrips and ports are minimal, solar and battery arrays may be able to provide some or all the required power supply for short term use when planes and vessels are approaching, loading / unloading, or departing.

Tetlin's airport does not have daily scheduled flights, so the power demand is negligible.

2.1.6 EV's & Charging

Electric vehicles (EVs) are automobiles powered by electric motors that draw their energy from rechargeable batteries. Unlike traditional internal combustion engine vehicles that rely on gasoline or diesel, electric vehicles use electricity as their primary source of energy. Charging an electric vehicle involves replenishing the energy stored in its battery. Electric vehicle charging can occur at various locations:

- <u>Home Charging</u>: Most EV owners charge their vehicles at home using a residential charging station. These stations are typically Level 1 (120 volts) or Level 2 (240 volts).
- <u>Public Charging</u>: Public charging stations are available at various locations in the community. These stations can be Level 2 chargers or Level 3 (DC fast chargers), which provide a quicker charge.
- <u>Fast Charging</u>: Fast charging, often available at public charging stations, utilizes Level 3 chargers to provide a rapid charge to the EV battery.

EVs face unique challenges in remote areas of Alaska due to the state's vast geography, harsh climate, and limited infrastructure. Some of the key challenges include:

- <u>Limited Charging Infrastructure</u>: Remote areas in Alaska often lack an extensive charging infrastructure for electric vehicles.

- Cold Weather Impact: Alaska's extreme cold temperatures can significantly impact the performance of electric vehicle batteries. Cold weather reduces the efficiency of batteries, leading to a decrease in driving range.
- Limited Support Services: Access to specialized support services for electric vehicles, such as trained technicians and repair facilities, may be limited in remote areas.
- High Initial Cost: The upfront cost of purchasing an electric vehicle and installing home charging infrastructure can be relatively high.
- Islanding Issues: Many remote communities in Alaska operate as microgrids, generating power locally. The integration of EVs may pose challenges in managing the power flow, especially if the microgrid wasn't initially designed to accommodate the unique characteristics of electric vehicle charging. Many remote areas in Alaska have power grids designed to meet the basic needs of the local population. The introduction of multiple EVs charging simultaneously can strain the grid's capacity, potentially leading to voltage fluctuations, outages, or the need for costly grid upgrades.

Tetlin does not have plans to incorporate EV charging stations at this time.

2.1.7 Hydrokinetic

Power can be extracted from rivers by harnessing current using an in-river turbine or by harnessing elevation head with an impulse-style turbine. Impulse-style turbines have a better track record in Alaska, with several successful installations throughout the state even though this type of power generation requires significant elevation head (ANTHC 2024).

Hydrokinetic systems have moving or rotating parts, similar to wind energy systems, that require more frequent and potentially more labor-intensive maintenance than systems that do not have moving parts (e.g., solar + battery arrays, wood chip boilers). Alaskan rivers also can have a high silt content, which is extremely abrasive and can obstruct the moving components of turbines. If consistent maintenance is required, it may be challenging due to the turbine's location in the flowing waterbody.

Rivers in Interior Alaska freeze in the winter, making power generation limited to the summer and shoulder seasons, with turbines removed in winter. Even turbines mounted on the river bottom under ice would need to contend with significantly reduced winter flow rates, which limits power generation. Design, research (e.g., stream gauging), and preparatory work are required prior to construction. For these reasons, in-river hydrokinetic systems have not yet demonstrated that they can provide cost-competitive power to rate payers.

Tetlin is situated along the Tetlin River near the headwaters of the Tanana River. However, there is no mention of pursuing a hydro related project in Tetlin.

2.1.8 Heat Recovery

Approximately one-third of the energy produced by diesel-fueled engines is harnessed to generate electricity, while the remaining two-thirds are dissipated as heat, either expelled through an exhaust system or rejected through the cooling radiators. A heat recovery system can reclaim a portion of the heat expelled via radiators and use it to warm nearby buildings, thereby improving generator efficiency. However, the equipment and piping required to transfer heat through these systems can be expensive.

In Tetlin, it is unlikely that fuel savings resulting from heat recovery would justify the high cost of implementing such a project.

2.1.9 Weatherization

Weatherization refers to the process of designing, preparing, or modifying buildings and their components to effectively retain heat and slow its dissipation to the outside elements by conduction or convection. Through weatherization, buildings are made more energy-efficient and weather-resistant, typically with the goal of improving comfort, reducing energy consumption, and lowering utility costs. Through weatherization programs, communities may implement a series of measures to enhance the insulation, sealing, and overall efficiency of a structure to ensure that it can better withstand external weather conditions. Weatherization measures can be applied to both residential and commercial buildings and may include insulation, air sealing, upgrading windows and doors, and optimizing heating or cooling systems.

Weatherization helps reduce GHG emissions by improving the overall energy efficiency of buildings, which, in turn, decreases energy demand from traditional fossil fuel-based power sources. By addressing energy inefficiencies in buildings through weatherization, a significant portion of GHG emissions related to energy consumption can be mitigated. This makes weatherization an essential component of broader strategies aimed at achieving energy sustainability and combating climate change.

In Tetlin, home rehabilitation and weatherization services have been completed by Tanana Chiefs Conference (TCC) Housing Department. From 2003 through 2020 TCC has helped rehabilitate approximately 20 homes in the community. In 2014 alone, TCC helped weatherize 5 homes. Additional weatherization of housing and building components in Tetlin would reduce heat loss and improve energy efficiency.

3 PCAP Elements

This PCAP includes the following elements:

- A GHG inventory
- GHG emissions projections and reduction targets
- Quantified GHG reduction measures (priority measures)

- A benefits analysis
- A review of Authority to Implement
- Identification of other funding mechanisms

3.1 Tetlin Community Survey

Tetlin Village completed a community survey that was issued to the Tribe by Tanana Chiefs Conference in late 2023. A copy of the survey is provided as Appendix A. This survey provided the Tribe with an opportunity to comment on their energy priorities and challenges, weatherization and electrical needs, and interest in renewable energy systems.

The Village of Tetlin completed a community survey that was issued to the Tribe by Tanana Chiefs Conference in late 2023. This survey provided the Tribe with an opportunity to comment on their energy priorities and challenges, weatherization and electrical needs, and interest in renewable energy systems.

The survey completed by the community of Teltin indicated they do not currently have an energy/economic development plan but would like help writing one. Their three top energy priorities are to reduce the cost of electricity, reduce the cost of home heating and reduce the energy costs of public buildings and facilities. Teltin currently uses the Tok powerplant via AP&T. The Village of Teltin is reliant on AP&T's Tok powerplant; there is no back up energy available in Tetlin.

The Village of Teltin indicated that it does not have a heat recovery system and does not have any renewable energy projects in their future. The Village of Teltin is interested in the following type of projects for the future:

- Community-scale solar photovoltaic systems
- Battery energy storage systems

The highest priority for Tetlin is to reduce the costs of energy and heating for the Village of Tetlin along with funding to pursue renewable energy such as solar power generation. The Village of Tetlin's population and geographic size should allow for the community to provide a high percentage of renewable energy combined with solar, wind, etc. Over 80% of the residences in Tetlin are in need of being weatherized including LED lighting upgrades, doors, windows, Toyo stoves, wood stoves, leveling homes and painting. The community would be interested in additional weatherization as recommended. Eighty percent of the homes are older and lacking basic utilities including power, water and sewer.

The Village of Tetlin would be interested in having an energy audit as they have never had one. Tetlin's community buildings are also in need of weatherization including LED lighting and energy efficient Toyo stoves. Tetlin would be interested in weatherization retrofits for their community buildings. Over half of their community buildings do not have basic utilities, including power, water and sewer.

Tetlin is interested in applying for EPA Climate Pollution Reduction Grants. Their highest priority is applying for energy efficient upgrades along with solar power + BESS to power the community to relieve the reliance on higher cost power.

3.2 Greenhouse Gas (GHG) Emissions Inventory

An Alaska Emissions Inventory Tool was created to assess GHGs emitted from 245 communities around Alaska, including Tetlin (Constellation Energy, 2024). The inventory tool was developed using modeling informed by federal and state datasets in addition to local data contributions, where relevant. Many community-level inventories accessible through this tool were updated in collaboration with their relevant tribal CPRG grantees. The tool will be continually updated with additional emissions sectors and more community-level data as part of planning for the state's Comprehensive Sustainable Energy Action Plan (CSEAP).

Briefly, the methodology used in the inventory involved the collection or modeling of energy, fuel, and vehicle data, and the calculation of GHG emissions based on fuel types and uses from different sources and sectors. The inventory used the standard international protocols and methodology to determine metric tons of carbon dioxide equivalent ($MTCO_2e$) for three greenhouse gases: carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O).

There are two major approaches to scope 2 emissions accounting. One uses the location of the purchased electricity consumption to approximate the greenhouse gases emitted to the atmosphere. This location factor is based on the electricity physically delivered to the organization or reporting entity. It relies on average regional grid emission factors and reflects the average emissions intensity of grids on which energy consumption occurs. The other method, termed "market-based" accounting, calculates the emissions from the electricity the reporting entity purchases through direct contracts with suppliers. This method supports and uses any relevant reporting of green energy tariffs, such as via Renewable Energy Certificates (REC) and Guarantees of Origin (REGO), etc.

Purchased heating, steam, and cooling are classified and usually purchased from a supplier in weight or BTUs, often with power generation. Steam capacity is often transferred for use in buildings, such as for cooking, but also industrial applications in turbines. If the combustion leading to the steam is conducted in equipment owned by the organization, the fuel source being used would be counted as their scope 1 emissions, similar to accounting for electricity emissions. Similarly, steam is usually purchased from a supplier in weight or BTUs, often with power (co)generation. The heat generated in such centralized locations is distributed through a system of insulated pipes for a buildings' heating requirements, such as space heating and water heating. If the biomass, fossil-fuel or renewable energy-based co-generation plant is owned by the organization, the fuel usage will be reported as their scope 1 stationary emissions.

Lastly, district cooling systems, if available, use water chilled by cooling plants (chillers or residual heat for cooling) which travels from the upstream plant to the organizations' buildings to cool the space. Fossil or renewable feedstock used in these systems, if owned by the organization, would be reported as their scope 1 emissions.

3.2.1 Stationary Combustion

The Alaska Emissions Inventory Tool estimates Direct GHG emissions from records of stationary (non-transport) combustion of fossil fuels at facilities and includes combustion within boilers, turbines, and process heating, but also incorporates end-uses like space or water heating, and appliances. The data forTetlin stemming from the Alaska Emissions Inventory Tool pertain to residential, commercial, community and industrial buildings and facilities:

- **23.81%** of the community's emissions come from the **residential sector.**
  - Residential Fuel Oil No. 5: 66.00 MT GHG Emissions (18.43%).
  - Wood and Wood Residuals: 19.24 MT GHG Emissions (5.38%).
- **68.81%** of the community's emissions come from the **commercial sector.**
  - Distillate Fuel Oil No. 1: 228.27 MT GHG Emissions (63.76%).
  - Propane: 17.43 MT GHG Emissions (4.87%).
  - Wood and Wood Residuals: 0.63 MT GHG Emissions (0.18%).
- **A negligible amount** of the community's emissions come from the **industrial sector.**

3.2.2 Transportation

Direct GHG emissions associated with fuel combustion in owned or operated mobile sources, such as on-road vehicles (passenger vehicles, trucks,) and off-road vehicles (planes, boats) or equipment (air support, construction, etc.).

- **7.38%** of the community's emissions come from the **transportation sector**
  - Aviation Gasoline: 26.43 MT GHG Emissions (7.38%)
- **On-road**
  - None reported
- **Non-Road**
  - Passenger: 141.626 MT GHG Emissions (9.64%)

3.2.3 Purchased Electricity

- **0%** of the community's emissions come from **purchased electricity**.
- **The total electricity** used is **417.70 MWh.**

3.3 AEA PCE Reports

Data from the AEA's PCE Program Statistical Report for FY2022 was reviewed to best understand the State of Alaska's assessment of financial and emissions estimates in Tetlin (AEA 2023). To assist AEA in developing this report, eligible utilities submit monthly reports to AEA that document the eligible power sold and PCE credits applied to eligible customers' bills. AEA then calculates the amount of PCE on a monthly basis, and after verifying the eligibility of customers and of community facilities, issues a subsidy payment to the utility. AEA calculates required pro-rated PCE levels based on available funds.

The Regulatory Commission of Alaska (RCA) determines the PCE level per kWh for each utility. Two categories of costs are used in determining the PCE level: a) fuel expenses: the cost of fuel, including transportation of fuel; and b) non-fuel expenses: salaries, insurance, taxes, power plant parts and supplies, interest and other reasonable costs.

The AEA PCE data for Tetlin indicated that diesel was the primary energy source of power and GHG emissions in Tetlin in 2022 (AEA 2023). Tetlin's 50 residential customers, 5 community facility customers, and 10 other customers required a portion of the 10,513,000 kWh of diesel-generated power and 0 kWh of non-diesel-generated power from the Alaska Power & Telephone Company (AP&T) facility in Tok which also provides power to the communities of Tok, Tanacross, and Dot Lake. A total of 417,783 total kWh was sold to Tetlin customers requiring approximately 4% of the powerhouse consumption of the 724,329 gallons of diesel fuel (approximately 28,973.16 gallons) at the AP&T facility. Assuming that 22.38 lbs CO_2 are produced per gallon of diesel consumed, it can be determined that Tetlin accounted for approximately 648,419 lbs CO_2 produced by the AP&T facility in FY2022.

A total of 724,329 gallons of fuel were consumed at the AP&T facility (about 28,973.16 by Tetlin customers) at a cost of $2,166,028 ($2.99 per gallon; $86,629.75 for Tetlin customers). The average fuel cost per kWh in Tetlin in 2022 was $0.25. The annual non-fuel expenses associated with power generation at the AP&T facility totaled $1,890,212 in FY22, resulting in an additional cost of $0.22 per kWh sold. Thus, the combined fuel and non-fuel expenses at the AP&T facility required to produce power for Tetlin were $0.47 per kWh sold in FY22. The last reported electric rate paid by customers was $0.57 per kWh. Tetlin's electric rate is over 3.5 times the national average of $0.16 per kWh. Tetlin was PCE eligible for 51.5% of its total kWh sold in Fiscal Year (FY) 2022 resulting in PCE payments to Tetlin in the amount of $62,161 to offset its high energy costs. The average annual subsidized PCE payment per eligible customer was $1,130 (AEA 2023). PCE data are summarized in Tables 1 and 2, below.

Table 1. Tetlin Population and Customer Base

Community Population	Residential Customers	Community Facility Customers	Other Customers (Non-PCE)
106	50	5	10

Source: AEA 2023

Table 2. Tetlin Fuel Consumption and CO2 Emissions

Diesel kWh Generated*	Non-Diesel kWh Generated	Efficiency (kWh Sold / Generated)*	Fuel Efficiency (kWh/ Gal. Diesel)*	Total kWh Sold + Powerhouse Consumption	Fuel Used (gal)	CO2 produced[6] (lbs)
10,513,000	0	82.5%	14.5	417,783	28,973	648,419

Source: AEA 2023, * AP&T for Tetlin, Tok, Tanacross and Dot Lake combined

While AEA's PCE Program is critical for rural residents, one unintended consequence of it is that there is little incentive for utility-owned renewables. This is because any savings of generation costs stays with the PCE endowment fund, which pays out communities in accordance with a prescribed formula, rather than being passed on to the community itself. However, if a community owns the renewable asset and sells power to the local electric utility at a price close to the avoided cost of fuel (in essence acting as an IPP), the PCE payment is preserved and the revenue from power sales stays in the community (as noted in ANTHC 2024). This maintains the utility's costs at its current level and thus its PCE payment, thereby ensuring that economic benefits of the renewable energy system benefit the community. While revenue from power sales cannot be used to reduce electric costs directly, it can be used to reduce costs of other utilities, such as water, sewer, heating, or it can be saved for future community investment.

3.4 GHG Reduction Targets

Tetlin may pursue reduced GHG emissions through opportunities that would result in:

- Tok-Delta Transmission Line Intertie. 110 Mile, 69 KVA; or 25KVA distribution line with GHG reduction target of 3441 tons Co2 annually/ 136,652 tons Co2 over 40 year project life;
- A community solar + BESS project that could reduce CO_2 emissions by about 20%;
- A woodchip boiler that could heat community buildings and thereby reduce emissions;
- Weatherization to retain more heat in buildings, thus producing fewer GHGs.

[6] Assumes 22.38 lbs CO_2 are produced per gallon of diesel consumed.

- An assessment of whether wind would be practical or lucrative.

3.5 GHG Reduction Measures

Existing tribal goals and policies work towards overall GHG emissions reductions, and these can be expanded further as long as they do not have a significant financial impact to the Tribe or the broader community. The above targets may be pursued by the community in the future, working with TCC or others. Additionally, educational programs and public outreach efforts may be developed to assist in efforts for GHG reduction.

1. **Tok – Delta Transmission line intertie.** The community will apply to have a Tok-Delta high voltage Transmission Line Intertie between Tok/Tanacross and Delta.
2. **Community Scale Solar PV and BESS.** The community should apply for funding for a 2MWe solar array project along with 3MWe BESS.

3.6 Benefits Analysis

An analysis was performed under a scenario in which 24% of a typical TCC community's current energy usage would be displaced by energy from solar PVs + BESS. Using HOMER Pro software, TCC determined the PV power output, optimized number of BESS Lithium (Li) batteries, fuel consumption, and reduction in generator-produced power. Results are provided in Table 3, below.

Table 1. TCC Community Modeling: 4MW Renewable Solar + 4MWH BESS Scenario

PV (kW)	PV Energy Production (kW / yr)	1 kWh Li BESS (#)	CAPEX ($)	Renewable Fraction	Fuel Use Reduction (gallons)	Annual CO2 Reduction (MT)
4000	12,000,000	4000	21.2M	24%	137,622.51	1,396.17

Source: HOMER Pro Software

Results of this modeling demonstrated a benefit of reduced fuel consumption and costs in the community, coupled with reduced greenhouse gas emissions.

Rural and Remote Energy Challenges and Project Impacts

While AP&T produces much of its power through renewables in other regions of the state, the Tok service area generation for the communities of Tok, Dot Lake, Tanacross, and Tetlin is 100% diesel powered due to legacy infrastructure and the high cost of diversifying from diesel generation in the region. The rural and remote communities of the Upper Tanana region experience exceptionally high diesel fuel costs for electricity generation, which are exacerbated by the costs to transport the fuel great distances in remote Alaska. Diesel prices are also subject to high levels of variability due to unpredictable changes in the global market. This translates to high residential retail power rates of$0.43/kWh. This is over three times the national average of $0.137/kWh.

TCC and AP&T's chief concerns around Upper Tanana region's electrical infrastructure is finding methods to create affordable and reliable electricity. In the past, this has included AP&T's attempts to develop Organic Rankine Cycle, Natural Gas, Wind, Biomass and Hydro-electric generation projects in the area. TCC has worked toward installing small renewable projects, yet these by themselves do not benefit all residents in these rural and remote communities and do not meet the full range of power needs. None of these efforts have succeeded in diversifying the region's overall reliance on diesel fuel for power generation.

The high cost and price variability of diesel in these rural and remote communities discourages beneficial electrification and depresses the load base, preventing the region from finding economies of scale in electricity production or further developing the local economy. AP&T's diesel generation plant in Tok is operating past its designed useful life; buildings date from the 1950s and over half the engines are nearing 100,000 hours of operation. Unless relegated to standby status, significant costs will be required to maintain the Tok diesel infrastructure, which will be reflected in increased power rates, further burdening an already overburdened population. The existing older equipment is also more prone to disruptive outages. The existing transmission infrastructure between the Tok diesel powerplant and the Upper Tanana communities is vulnerable to climate change-induced damage from increased lightning and wildfires, as well as degrading permafrost. Connecting the Tok diesel-powered grid to the much larger and lower cost Railbelt grid will stabilize electrical costs and decrease the Upper Tanana region's carbon footprint by providing access to the Railbelt electric grid and Golden Valley Electric Association's diversified generation portfolio, which boasts the Railbelt's highest percentage of renewable generation from both large wind power and hydropower. Access to this and other Railbelt generation through the intertie will reduce the reliance on costly diesel fuel.

The access to lower cost power through the Railbelt connection will also increase grid resilience and energy affordability in the small and isolated populations in the Upper Tanana communities. Completion of the proposed intertie would also enable AP&T to pursue development of nearby wind and hydroelectric resources and continue expanding a solar array in the service territory being installed in 2023. Without the limitation of a fixed, low base of electrical consumption in the islanded rural and remote grids, local renewable generation project financial feasibility will increase significantly. This project will unlock access to these renewable resources for the benefit of the rural and remote communities of the Upper Tanana, as well as the entire Railbelt in Alaska, and contribute towards the State of Alaska goal of providing 50% of all electricity through renewable resource by 2025.

Transmission Line Intertie Energy Impacts on Rural and Remote Communities

The proposed project benefits the rural and remote Alaska Native communities of Dot Lake, Tanacross, Tetlin, and Tok in the Upper Tanana region by constructing a transmission line that replaces primary diesel generated power and makes existing Railbelt renewable energy sources such as Bradley Lake hydropower and Delta wind power available in these communities. The intertie also provides greatly increased resiliency to a stand-alone Tok electrical grid that is otherwise 100% reliant on aging diesel-fueled infrastructure.

Benefits from this Intertie project are numerous, including total energy transfer capacity improvements, increased electric power reliability throughout the Alaska road system not subject to interruption by a single line outage, development of future power generation, increased ability for the grid to accept renewable energy and provide significant spatial diversity for these resources, economic benefits including reduced power costs for rural communities and support for regional economic development opportunities, and potential for additional Department of Defense facility resilience. This smaller 69kVa line will be right sized for the present while allowing substantial opportunity for the future.

The proposed project would connect four rural and remote communities currently in an islanded microgrid and provide a proof-of-concept for expansion of the Railbelt grid to other small communities. Lessons learned and efficiencies will be collected and implemented in future projects, reducing the overall federal dollars needed to complete similar interties in many other remote islanded diesel-powered microgrids across Alaska.

3.7 Review of Authority to Implement

The Tetlin Tribal Council (TTC) is the governing body for Tetlin Village, a federally-recognized tribe. The TTC has the authority to implement GHG reduction measures through resolutions passed in TTC meetings in which a quorum is present.

Milestones achieved for reducing GHGs include community outreach, TTC meetings, and letters of support. A schedule of milestones may be developed to implement each reduction measure included in this report.

4 Next Steps

4.1 Identification of Other Funding Mechanisms

TCC has recommended the following projects should be pursued by Tetlin to reduce GHGs:

1. **Tok – Delta Transmission line intertie.** The community will apply to have a Tok-Delta high voltage Transmission Line Intertie between Tok/Tanacross and Delta.
2. **Community Scale Solar PV and BESS.** The community should apply for funding for a 2MWe solar array project along with 3MWe BESS (top priority).
3. **Residential Weatherization.** It is likely that the homes in Dot Lake have not had further weatherization beyond their initial construction. Updated weatherization could create significant energy savings and make residents more comfortable.
4. **Biomass Project(s):** The Gam wood-fired boiler that is used to heat a number of homes in Dot Lake had some initial design flaws, including buried pipes that were easily damaged. Dot Lake should consider applying for funds for maintenance and to potentially expand the number of homes this project serves.

5. **Wind Energy Study:** A full wind energy study should be performed prior to pursuing design or capital funding for the project. Wind-powered turbines may be able to provide additional fuel savings, including during winter. However, the wind source around Dot Lake is considered marginal, and maintenance costs should be considered. A wind study is likely to require deployment of one or more meteorological monitoring stations to characterize the resource in the desired area(s). Alternatively, a LiDAR wind profile could be installed in lieu of a meteorological station to save costs on a wind study. The economics of wind projects in Interior Alaska should be included in this study to better understand operating and maintenance costs versus benefits.
6. **Other Steps:** The community should examine the condition of the current power grid as it likely has not been updated since the lines were initially installed.

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