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McGrath, Alaska Community Energy Plan

Fall 2024

McGrath Energy Committee and ETIPP Technical Team

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September 27, 2024

This report was produced when the laboratory operated as the National Renewable Energy Laboratory (NREL). The laboratory is now the National Laboratory of the Rockies (NLR).

Photo by Molly Rettig, National Laboratory of the Rockies 68829

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The U.S. Department of Energy's Energy Technology Innovation Partnership Project (ETIPP) works alongside remote and island communities seeking to transform their energy systems and increase energy resilience. The City of McGrath took part in the ETIPP program in 2023-2024. As part of the project, community members formed the McGrath Energy Committee, made up of residents and local stakeholder organizations. The McGrath Energy Committee then worked with technical advisors from regional associations, university programs, and national labs to conduct a baseline energy assessment of the community, organize a community energy education series, identify key focus areas relevant to McGrath, explore funding opportunities, and create the McGrath Community Energy Plan. This plan serves as a foundational guide for future energy projects in the community, aligned with McGrath's long-term energy goal: "to be a catalyst to encourage energy resiliency in our community and the Upper Kuskokwim Region."

- November 2024

1. Introduction

1.1 About the Community

Key energy and resilience challenges

- The energy system supporting McGrath is vulnerable and costly.
- McGrath’s electric and water utilities are especially vulnerable.
- The high cost of fuel is a threat to the community.
- McGrath must explore ways to reduce reliance on petroleum as the single fuel source.

A community improvement survey was conducted in August 2021. Residents identified thirteen major areas for improvement. Of these, ”Encouraging alternative power sources –solar, hydro, or wind technologies- to supplement diesel energy” was ranked as the top priority by community members that responded. As a responsible steward for our future, the City must explore and learn about new and emerging energy technologies

-ETIPP Application 2022

McGrath City Hall. Photo from NLR

1.1 About the Community: Demographics

Census Decadal Population Counts:

Census Year	Population
1880	0
1890	0
1900	0
1910	0
1920	90
1930	112
1940	138
1950	175
1960	241
1970	279
1980	355
1990	528
2000	401
2010	346
2020	301

Source: Alaska Community Database: https://dcced.maps.arcgis.com/

Energy 101 session, summer 2023. Photo from NLR

About the Community: Utilities

Electric (based on FY 2023 PCE Data):

Power Source	Diesel
PCE Provider	McGrath Light & Power
Effective Residential Rate	$0.4006
PCE Disbursements YTD	$284,344.0

Fuel Prices (Summer 2024):

Retail Gas Price	$8.51
Gas Vendor	Northern Petroleum
Retail Heating Fuel Price	$8.22
Heating Fuel Vendor	Northern Petroleum

Water Treatment:

Water Treatment System Facility	Primary Water Source	Number of Residents Served	System Class	System Capacity
McGrath Water Treatment System	Surface Water	321	WT 2	No Data

Water Distribution:

Water Distribution Facility	Number of Residents Served	Number of Service Connections	Water Distribution System Class	Circulated or Heated System
McGrath Water Distribution System	321	160	WD 2	Yes

About the Community: Fuel

Bulk Fuel Inventory:

Owner	Owner Contact	Number of Tanks	Gasoline Capacity	Diesel Capacity	Total Capacity
McGrath Light & Power, LLC	907-644-1200	4	No Data	392500	392500
City of McGrath	907-524-3825	4	5000	36000	41000
McGrath Airport	907-269-5980	3	No Data	16000	16000
Iditarod Area School District - McGrath	907-524-1201	1	No Data	10000	10000
Federal Aviation Administration - McGrath - MCG	907-269-1150	1	No Data	10000	10000
AT&T - McGrath	800-566-9347	1	No Data	1000	1000
Yukon Fuel Company, McGrath	No Data	No Data	No Data	No Data	No Data
Crowley Bulk Fuel Facility, McGrath	No Data	No Data	No Data	No Data	No Data

Source: Alaska Bulk Fuel Inventory, hosted by AK Division of Community and Regional Affairs Information Portal

McGrath Energy Committee

- At the inception of the ETIPP program, the City of McGrath convened multiple groups of stakeholders to be represented in the McGrath Energy Committee.
- The group includes
  - City of McGrath (“McGrath”)
  - McGrath Native Village Council (MNVC)
  - MTNT, Inc. - regional Alaska Native corporation
  - McGrath Light & Power (ML&P) - utility serving McGrath
  - Iditarod Area School District

Community Decision-Making Workshop, 2024. Photo from NLR

Contributors

Michele (Miki) Greenamyre, McGrath, clerk / treasurer

Greg Knight, McGrath, administrator

Barb Deardorff, McGrath, councilmember

Tim Yoder, McGrath, councilmember

Joyce Turner, IASD

Sarah McClellan, McGrath citizen

Erin Norback, MNVC

Kim Wortman, MNVC

Lewis Egrass, ML&P, power plant operator

ETIPP Technical Team

NREL

REAP

Seal of the City of McGrath, Alaska

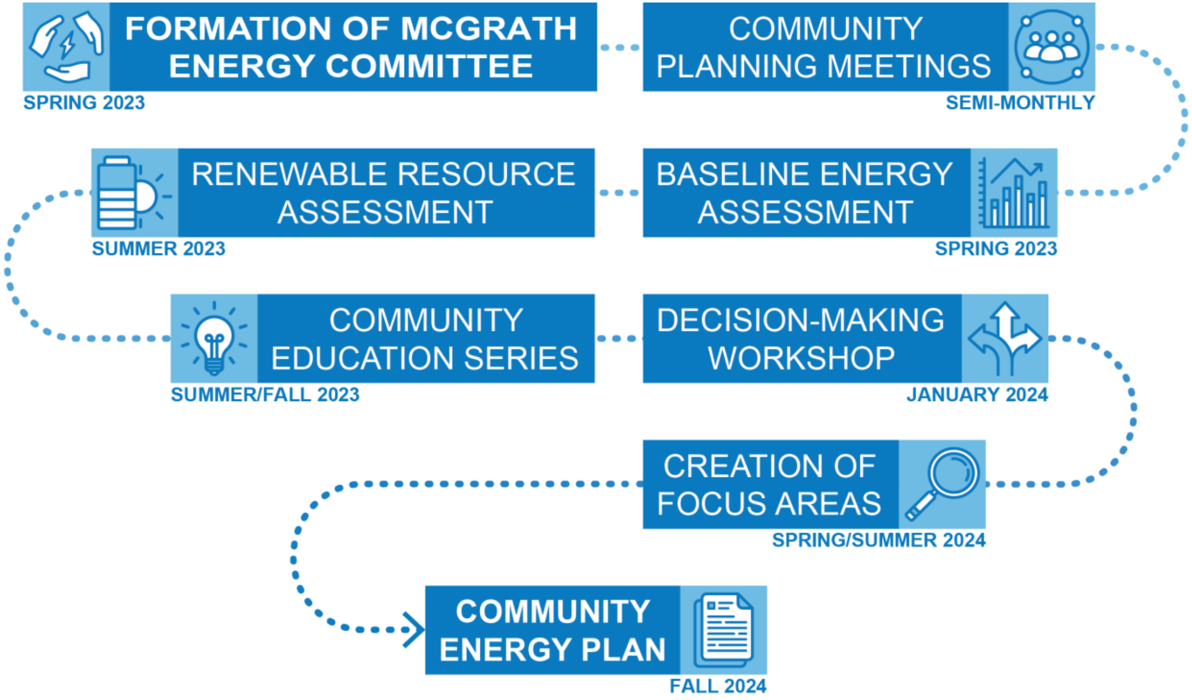
Alaska Native Tribal Health Consortium

Tanana Chiefs Conference

ACEP Alaska Center for Energy and Power

Energy 101 session, summer 2023. Photo from NLR

Community Energy Plan Process



Baseline Assessment

2.1 Electricity Generation

2.2 Electrical Distribution

2.3 Heat Recovery System

2.4 Water & Sewer

Baseline: Electricity Generation

- McGrath Light & Power (ML&P), established in 1978, is the electric utility serving McGrath; ML&P is owned by MTNT Energy, LLC, a holding company of MTNT, Ltd., an Alaska Native Corporation (McGrath, Takotna, Nikolai, Telida).
- 2020-2021, MTNT built a new power plant building and replaced its antiquated/problematic CAT gensets with four Detroit Diesel Series 60 gensets that meet EPA requirements for diesel power generation in remote areas of Alaska via funding from the 2020 High Energy Cost Grant (U.S. Dept. of Agriculture).
- The electricity is generated by the four new Generator Sets - Rated at 350kW including three equipped with Heat Recovery Units.
- To maximize efficiency, the generator sets aim to operate within an optimal load range, avoiding extremes that reduce performance and increase wear. The system alternates between sets to balance load and distribute run time evenly.

Photo from NLR

Baseline: Electrical Distribution

- **System specs:** McGrath has a 2400V system for distribution (few remain in AK).
- **Load:** 250-300 kW annual average, down from 600 kW around 2010. The declining load has followed a decreasing population trend since 2005.[1]
- **Inefficiencies**: Line losses of +9%; 87% efficiency (consumed vs generated)[2]
- **Rate:** $0.40/ kWh (up to 750 kWh) effective residential rate, after PCE[2]
  - ML&P has not increased rate in 11 years, despite generally rising fuel prices statewide
- **Consumption and Conservations Trends**: 166,000+ gallons of diesel are consumed annually for electricity generation; 14 kWh/gal diesel; $5/gal from Crowley (2024)
  - There are 191 residential customers in McGrath who, on average, each consumed 2577 kWh in 2023; this compares to mean consumption across *all* PCE communities of 4042 kWh per residential customer.[2]
  - McGrath has demonstrated consistently low demand relative to other Alaskan villages, punctuating effective energy conservation measures have been in place over time.
- **Resiliency Infrastructure:** Back-up generators exist at DOT, City Hall, Clinic, and Alascom; *however*, *one has not yet been connected at the School*, which is designated as the village's emergency center. The school's generator will be installed in 2025.

Baseline: Heat Recovery System

- A waste heat recovery system makes use of excess heat from the power plant. Heat recovery/hot water loop runs year-round; the only way to turn the heat off is by bypassing the buildings.[1]
- Of the four generators, three have marine manifolds. Approximately 1/3 of the energy from diesel is captured by the jacket cooling system. Based on McGrath loads, approx. 400-500 MBH of heat is available to recover, roughly equivalent to ~20-25,000 gallons fuel / yr.[2]

- An exhaust economizer recovers additional heat from the hot engine exhaust.
- Recovered heat meets the power plant heat loads before warming two district heating loops that serve Downtown (Hotel McGrath, Innoko Lodge, and A/C Store) and the School (McGrath School, School Housing, other School District Buildings, and McGrath Clinic).
- Heat recovery performance could be tracked using school data for historic energy consumption.

[1] *Described by Lewis "Lucky" Egrass, ML&P 9/26/2024.*
[2] *Estimates made by Elan Edgerly, ANTHC.*

Heat economizer. Photo from NLR

Heat exchanger. Photo courtesy of the Alaska Native Tribal Health Consortium

Baseline: Water and Sewer

Water plant, city building and washeteria are on the same electric meter; FY24 consumption as of 10/25 was 33,340 kWh. One fuel tank heats the water that goes out as well as the building.[1]

Water plant fuel consumption in FY24 (Oct-June) totaled 10,587 gallons for $57,910.89.

Water and sewer systems are major consumers of fuel and energy, prompting interest to explore their operation and efficiency in the energy focus areas.

<u>Water Treatment and Distribution:</u>

- Raw water is pumped in from the Kuskokwim River. It is settled (during summer), treated, filtered, and disinfected before entering the 500,000-gallon water storage tank.
- Water is distributed from the water plant via two loops. Each loop is pressurized via 5 pressure pumps; each has a controlled circulation pump maintaining flow 180gpm (2ft/s in a 6" pipe) and a heat-add system that directs a portion of the return water through a double-walled heat exchanger.
- Daily Average Water Treated: 49,000 Gallons.[2]
- Daily Average Water Used or Sold: 7,100 Gallons.[2]

<u>Wastewater</u>**:**

- The city center has piped sewer, which is collected and pumped to a wastewater lagoon.

Photo courtesy of the Alaska Native Tribal Health Consortium

[1] Information provided by Miki Greenamyre, McGrath Clerk / Treasurer
[2] Limited Data available. This value is estimated based on reported values for November 2023, which was noted by the community to be representative of average values. Analysis to address discrepancy between treated and used is covered in Section 5.6.

Baseline Updates as of Meeting 09/27/2024

- Bulk fuel purchase was recently made of $800K for 160,000 gallons of diesel in preparation for winter 2024-2025.[1]
- One generator is not working at all as of meeting.[1]
  - New generators (as of 2021 upgrade) have required more service than prior / expected.
  - Discussions around strategies to address this are ongoing, including, but not limited to, a third-party assessment of new generators and/or use of old CAT generators as back up or even replacement.
- Energy Committee expressed interest in measuring impact **of heat recovery system on energy savings based on historical energy bills at the school before / after installment**.
- Efforts to curb water loss in water distribution system are ongoing.[2]
  - The city, in conjunction with work crews from private industry in the city, have been mapping out, digging for and identifying leaks, and clamping them. As of 11/13/24, water loss was 21 gpm @ 55 psi compared to approximately 60gpm at 30 psi since March '24.
  - Denali Commission has granted ~$80K to replace Water Plant heat exchangers.[2]
  - Waiting for processing of the award, to proceed with purchase and installation of the exchangers.

[1]*Information provided by "Lucky" Lewis Egrass, ML&P, powerplant operator.*
[2]*Information provided Greg Knight, McGrath Administrator, October 2024.*

Renewable Energy Resource Assessment

3.1 Solar

3.2 Water

3.3 Wind

3.4 Biomass

3.5 Geothermal

3.6 Data Gaps & Take-Aways

Motivation for a Renewable Energy Resource Assessment in McGrath

- Diesel prices at the pump in McGrath are around $8.70[1] per gallon, with costs expected to rise, making it an increasingly unsustainable energy source. The powerplant purchased 160K gallons of fuel for the powerplant for $800K in preparation for winter 2024 ($5/gallon diesel).
- Diesel is the community's only source of electricity, and the high cost has created a significant energy burden for residents, forcing many to leave the community in search of better opportunities, often at the expense of family ties and cultural connections.
- To address these challenges, the ETIPP technical team and McGrath Energy Committee engaged in discussions to identify and prioritize alternative energy options for exploration.
- Solar, water, wind, biomass, and geothermal were evaluated as potential sources for new generation. While micronuclear technology was discussed, it was omitted from the resource assessment due to its low technology readiness level. It is still an area of interest for the community, and they would like to track future TRL stages and periodically reevaluate.
  - Technology Readiness Levels (TRLs) is a measurement system used to assess the maturity level of a particular technology that ranges from TRL 1 (identification of problem) to TRL 8 (system/process completed and qualified through testing and demonstration). At the highest level, TRL9, technology is ready to move to commercialization.
- The resource assessment will be a key tool in identifying the most suitable technologies to meet McGrath's energy needs, guiding the community towards more sustainable, affordable solutions.

[1]Estimates were provided during a community meeting 5/16/2024, including statements from Lucky (Lewis Egrass, the McGrath power plant operator)

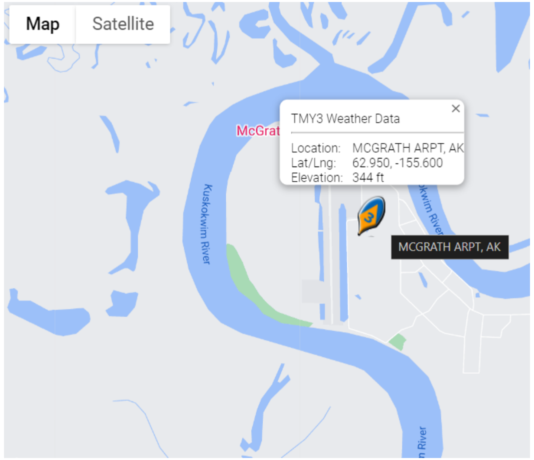
Solar Irradiance as an Energy Source

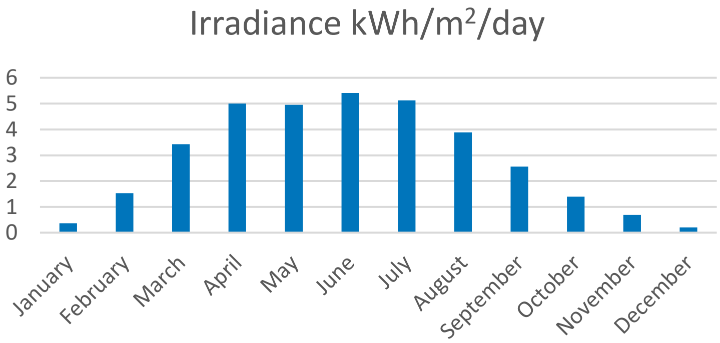
- **Resource Availability**: Observed irradiance at a point over time is ideal to estimate photovoltaic generation potential.
- **Unique Solar Profile**: Despite lower overall irradiance compared to sunnier regions, solar irradiance remains a competitive energy source for Alaska.
- **Seasonal Dynamics:** Solar energy potential is bolstered by prolonged daylight hours during the summer, which can significantly enhance solar output.

Overall, solar has significant potential as an energy source for McGrath. A feasibility and sizing analysis was completed and presented in focus area slides.

Seasonal Variability

- The National Solar Radiation Database (NSRDB) does not cover areas north of 60° latitude, like McGrath.
- Instead, solar resources were assessed using hourly data from McGrath Airport via NLR's PVWatts tool.
- The "TMY3" format data includes irradiance and temperature, both critical for estimating PV generation potential.





- Solar irradiance in McGrath is close to zero during the winter months.
- During summer, extended daylight hours result in significantly higher solar irradiance.

Water as an Energy Source

- Multiple projects have studied and continue to assess water as a power resource in the Kuskokwim River around McGrath.
- Case studies of hydropower and marine energy installations elsewhere in Alaska may be relevant to inform technical and deployment feasibility.
    - Tanana River conditions provide a comparison to the Kuskokwim in terms of silt and debris (trees).
    - Conditions in the Iliamna (Igiugig deployed device) are not comparable due to clear water.
- For hydropower, historical data and assessments which have been collected near McGrath are outdated and inconclusive when taken together. If hydropower is to be pursued, additional gage data should be collected and analyzed. There are no known plans for such data collection at the time of this report.

- Overall, marine energy, also called marine and hydrokinetics (as opposed to hydropower which utilizes elevation change or head), could emerge as an option for energy in McGrath but requires further research to understand its potential. Ongoing work toward that goal is presented in focus area slides.

Background on Energy from Water

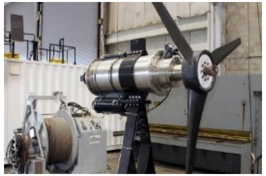
Marine Energy

Natural movement of water is harnessed, including waves, tides, river and ocean currents, and even temperature differences

Marine energy (ME), marine hydrokinetics (MHK)


River Current


Tidal


Ocean Current


Wave

Hydropower

Elevation difference, created by a dam or diversion, of flowing water to generate power; “hydropower” can refer to both hydroelectric and hydrokinetic power systems


Pumped Storage


New Low-Impact Projects


Non-Powered Dams & Conduits


Upgrades for Existing Hydropower

Historic Hydropower Research in McGrath

<u>Alaska Energy Authority</u>: Hydro (requires head and flow) assessment in McGrath (location 1139), 1981

236	Drop - Original report was strongly negative		236	es\SSH-1982-0221.pdf	1982	216	15	-142.3557378	60.1236366	Cape Yakataga (Porcupine Creek)
237	Drop - Original report was strongly negative		237	es\SSH-1982-0221.pdf	1982	217	15	-142.4315718	60.0659917	Cape Yakataga (Watson Peak, creek S of Mink Creek)
230	Drop - Original report was strongly negative		230	es\SSH-1982-0221.pdf	1982	210	15	-142.5379568	60.1374031	Cape Yakataga (creek W of Cotton Creek)
1975	Drop - Land compatibility issues	Wrangell St.	1975	s\HYD-1980-0241.pdf	1980	601	9	-142.5016152	61.2264094	Young Creek
1139	Drop - Too large for rural hydroelectric production purposes		1139	es\SSH-1981-0228.pdf	1981	604	1	-155.5958250	62.9563599	McGrath (Kuskokwim River)
186			186	s\HYD-1980-0241.pdf	1980	190	9	-147.2432374	63.3303374	Boulder Creek, 2
221			221	es\SSH-1982-0221.pdf	1982	201	15	-148.8296837	63.5642854	Cantwell-Broad Pass (Carlo Creek)
221			244	s\HYD-1980-0241.pdf	1980	201	9	-148.8296837	63.5642854	Carlo (Nenana River)

→AEA conclusions "too large for rural hydroelectric production;"
→Limitations: Data is old; unclear how determination was made

<u>U.S. Geological Survey:</u> Historic data collection

Date Time	Measuring Agency	Stream Flow (ft^3/s)	Gage Height (ft)	Control
2/15/2023 19:31	USGS	6500		Ice Cover
8/23/2022 11:35	USGS	26400	12.65	
6/30/2022 19:57	USGS	24100	11.61	
6/7/2022 19:01	USGS	28200	12.61	Clear
7/1/2021 11:43	USGS	19400	10.32	Clear

→USGS measurements inform potential, but lack of consistency, context making present interpretation and application difficult

<u>Kuskokwim River around McGrath</u>

Implications of Hydropower Research

Date Time	Agency	Stream Flow (ft/sec)	Stream Flow (gal per min)	kW at 80% efficiency (calculated)	Gage	Control
2/15/2023 19:31	USGS	6500	2917590	881		Ice Cover
8/23/2022 11:35	USGS	26400	11849904	3577	12.65	
6/30/2022 19:57	USGS	24100	10817526	3265	11.61	
6/7/2022 19:01	USGS	28200	12657852	3820	12.61	Clear
7/1/2021 11:43	USGS	19400	8707884	2628	10.32	Clear
10/2/1973 17:25	USGS	11100			9.21	
8/23/1973 13:45	USGS	28800			14.21	Debris Moderate
7/12/1973 7:20	USGS	23000			12.18	Clear

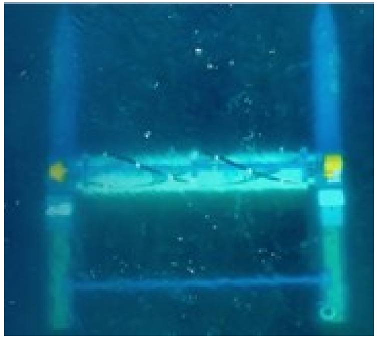
- Calculations estimate energy generation for a dam scenario with 2 feet of elevation change (head) at 80% efficiency
- Dam scenario is expensive and may not be the correct scale for community need; appears unrealistic for McGrath alone
- There has been limited data collected since ‘60s and '70s

River Turbines (Hydrokinetic)

- Differences from hydropower
  - Small impact on flow and marine ecosystem
  - Lower cost
  - Lower efficiency
  - High velocity / low head locations
    - Initial data from Kuskokwim suggests lower than ideal velocity
- Floating or bottom fixed support structures
  - Potential differences for installation and maintenance
- Two main turbine types: axial-flow and cross-flow
  - Additional non-traditional concepts exist
- Can use structures to deflect debris / ice
- Limited data shows successful coexistence with salmon (ORPC in Igiugig)
- Technology is in a pre-commercial state with a relatively low TRL. Pilot deployment may be feasible in the future, but the technology is not yet ready for full commercial deployment.

Verdant Power: Axial-Flow

ORPC: Cross-Flow



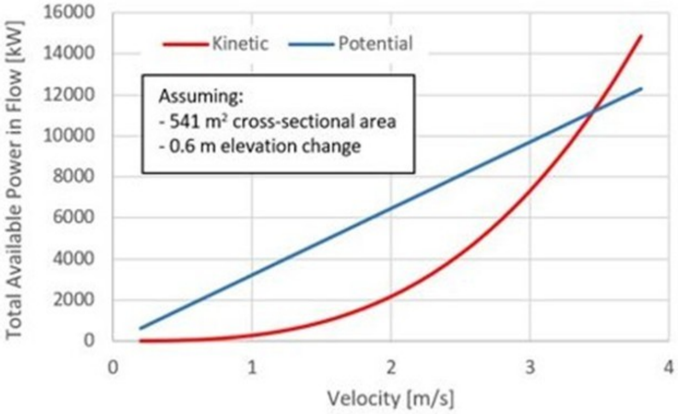
Marine Energy Data Needs for McGrath

- USGS data (used for hydropower assessment) only has volumetric flow, which doesn't allow for reliable hydrokinetic resource assessment
- Limited velocity data exists from 2022 ADCP (acoustic doppler current profiler instrument) measurements, taken by ACEP
  - Average velocity: 1.1 m/s
    - Near cut-in speed for many traditional turbines
    - Would only generate 41 kW with 150 m^2 turbine projected area
      - 28% of the river cross-section (no blockage effects included)
      - assuming a power coefficient of 0.4

More data is needed

- Flow distribution (are there local areas of the river with higher velocities?)
- Debris and ice data to assess survivability

Since this assessment, ACEP has been collecting new data to address some of these needs



Low available hydrokinetic power at 1.1 m/s

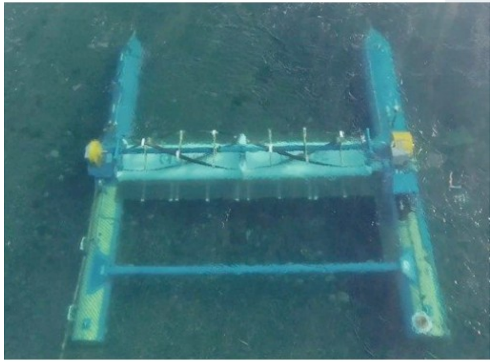
Case Study:
Tanana River Test Site (TRTS) by UAF

- The permitted stretch of river has been characterized for river velocity, bathymetry, debris characterization, sediment transport, hydrodynamics, power density and turbulence. Current velocity typically flows 1-2 m/s.
- Mandatory baseline fish stock studies have been completed. 2021 fish monitoring indicated no observed salmon smolt strikes (published 2022). Observation is difficult due to turbidity.
- ACEP researchers tested a Water Horse hydrokinetic energy system at the Tanana River Test Site for five days in July 2020. In 2021, a New Energy EnCurrent turbine was tested.

Water Horse hydrokinetic energy system Photo: ACEP

Case Study:
Kvichak River Power for Igiugig

- Relatively clear, debris-free river; current velocity typically 2-3 m/s
- Department of Energy Water Power Technologies Office funded ORPC RivGen® Power System for deployment, selected by Igiugig Village Council.
- Performance data on energy generation is being recorded and will be made publicly available in 2027.
- RivGen device outfitted with two sets of cameras positioned upstream and downstream for salmon monitoring during adult migration and smolt out-migration, required under permit by Alaska Department of Fish and Game.
- 2021 report from UAF observed smolt interaction with RivGen device with a small number of blade strikes and no mortalities; Cameras have captured millions of sockeye salmon smolt passing by the device.



RivGen device from ORPC at surface and bottom of river. Photos: NLR

Considerations for New Research

- Marine energy in-river turbine options, although at lower technology readiness levels, could become a viable clean energy option following a research and development period.
- Fish safety is a priority to communities, with existing case studies demonstrating early research on this area and underscoring the need for continued monitoring
- Marine Energy Projects Database details hydropower examples: https://openei.org/wiki/PRIMRE/Databases/Projects_Database
- Testing Expertise and Access for Marine Energy Research (TEAMER), supports marine energy projects and will be useful in conducting a more thorough resource assessment. Ongoing work is led by ACEP and summarized in the focus area section of the Community Energy Plan.

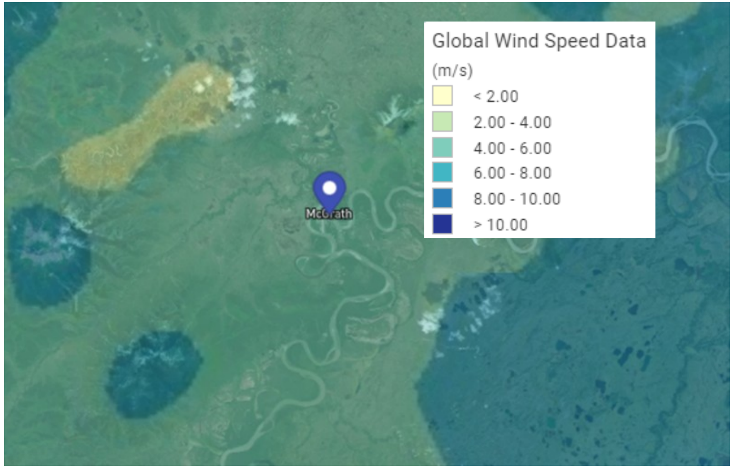
Wind as an Energy Source

- The Wind Integration National Dataset (WIND) Toolkit, developed by NLR, was used for a preliminary assessment of McGrath’s wind resource, and the Alaska Energy Authority Wind Resource Map (2010) provided supplemental information.
- Wind resource maps provide a general indication of good or poor wind resources, but do not provide a resolution high enough to identify local site features

Overall, current data indicates limited wind energy viability. Further on-site measurement would be necessary before pursuing this resource.

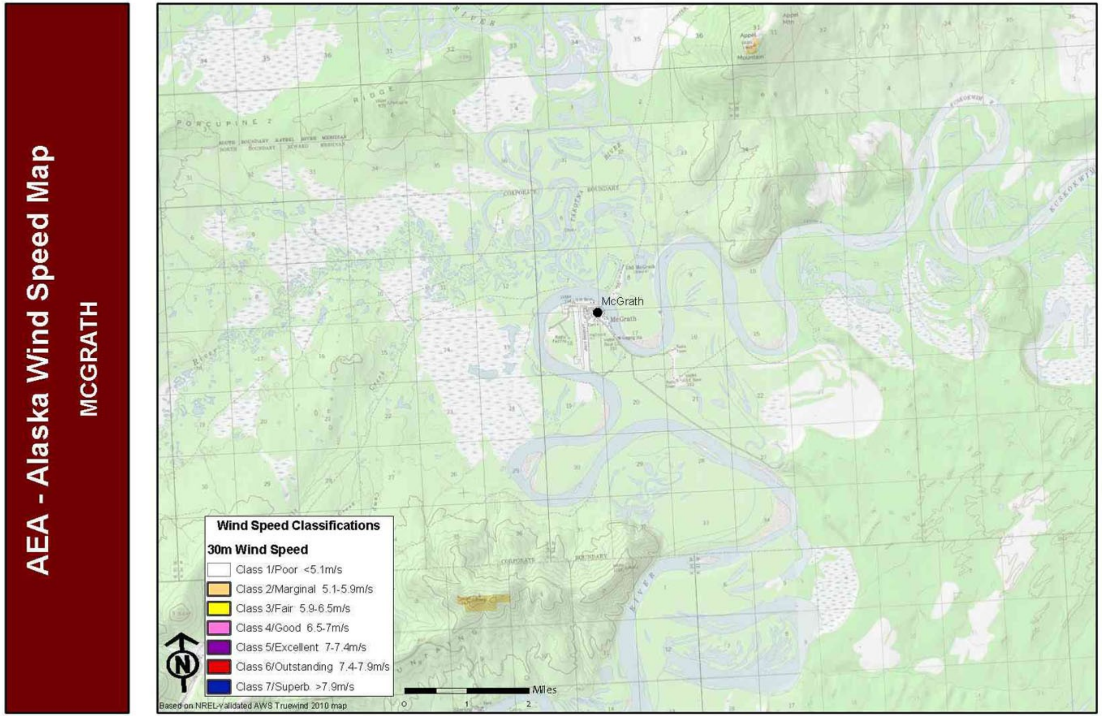
Wind Speed Estimates for McGrath

- The Wind Resource Integration Data (WIND) Toolkit, developed by NLR, models meteorological data including wind speeds over space and time. The WIND toolkit contains multiple datasets (below).
- WRDB Data Viewer (at right) shows wind speeds of 2-4 m/s (McGrath coordinate 62.956, -155.596).[1]
- WTK-LED data, with finer spatial / temporal resolution, was used to calculate McGrath average wind speeds of 4.59 m/s at 40 meters and 4.10 m/s at 20 meters, hourly to 5 min
- In both cases, these speeds are generally considered low for optimal wind energy generation.[2]
- Exploration of smaller turbines or turbines made for low-wind speeds could still be considered.
- A site-specific assessment would better inform McGrath's wind energy potential.



[1] https://wrdb.nrel.gov/data-viewer
[2] https://windexchange.energy.gov/states/ak

Wind Speed Estimates for McGrath



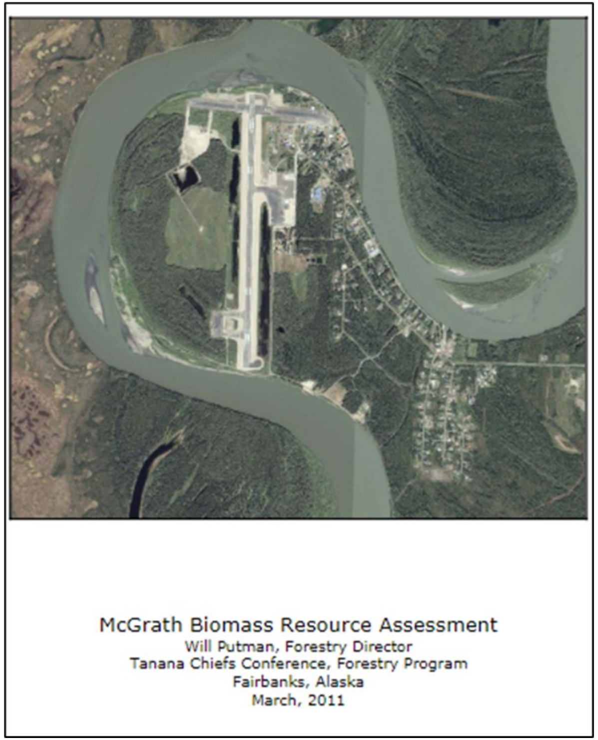
- Alaska Energy Authority published a wind report in 2011.
- The wind resource immediately around McGrath is classified as "Poor" with 30m wind speeds <5.1 m/s.
- The highest identified wind resource near McGrath (in orange) is "Marginal," two levels below the "Good" classification.

Biomass as an Energy Source

- Tanana Chiefs Conference (TCC), Forestry Program researched biomass potential for McGrath in 2011. That report is the basis for this resource assessment.
- Additional data (U.S. Forest Service, Alaska Energy Authority, imagery and remote sensing) could describe wood resource, but no known report provides high-resolution info for McGrath.
- Biomass is often not viable in Alaska due to underdeveloped industry, labor market, or low technology readiness.

Overall, biomass may be technically available for McGrath, but these challenges restrain implementation and limit its viability as an energy source.

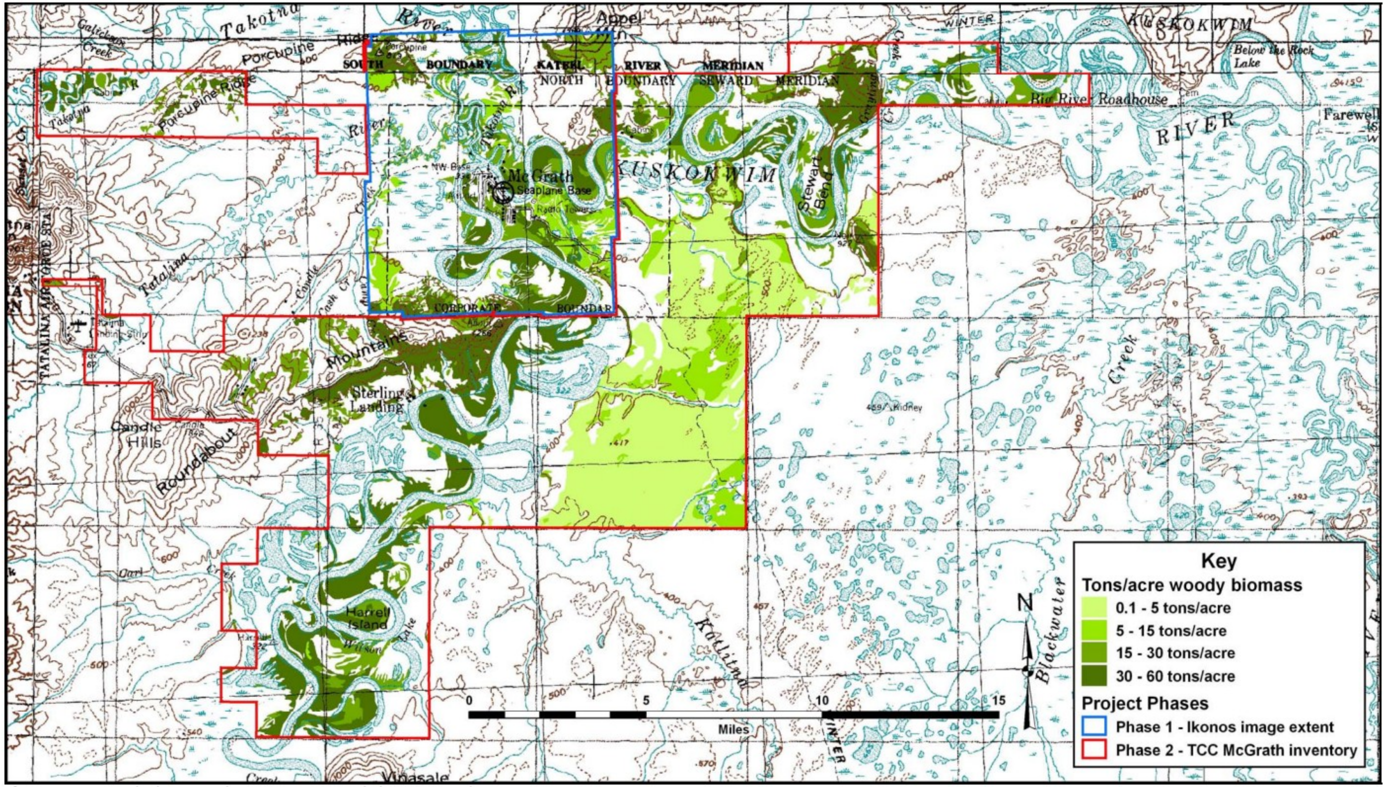
2011 McGrath Biomass Study


McGrath Biomass Resource Assessment
Will Putman, Forestry Director
Tanana Chiefs Conference, Forestry Program
Fairbanks, Alaska
March, 2011

- In 2011, TCC's Forestry Program conducted a biomass resource assessment for McGrath.[1]
- It's objectives were to:
  - Evaluate the potential of woody biomass as an energy resource for McGrath, Alaska.
  - Address the challenge of high fossil fuel costs and explore alternative energy solutions.
- Data on resource availability was collected by:
  - Studying resource and related factors near McGrath (Phase 1) and expanded geographic extent (Phase 2).
  - Interpreting land cover from high-resolution satellite imagery.
  - Integrating local forest inventory data.
  - Compiling ownership, management restrictions, cost parameters, and growth estimates.

[1]Putman, Will. McGrath Biomass Resource Assessment. Tanana Chiefs Conference, Forestry Program, March 2011.

Biomass by Mass



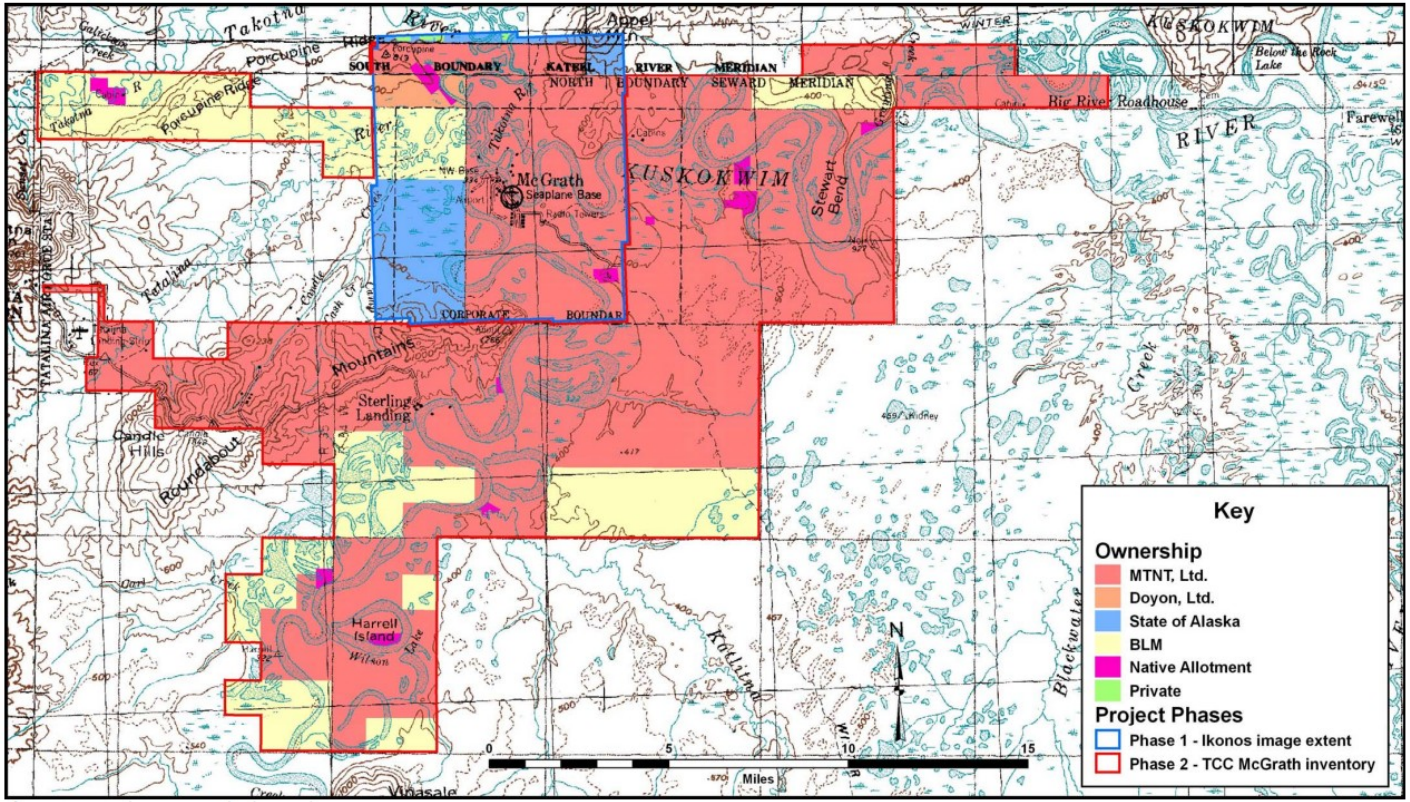
Putman, Will. McGrath Biomass Resource Assessment. Tanana Chiefs Conference, Forestry Program, March 2011.

Biomass by Cost – McGrath Village Area

Greater value indicates higher cost
of biomass harvest by mass

Putman, Will. McGrath Biomass Resource Assessment. Tanana Chiefs Conference, Forestry Program, March 2011.

Land Ownership



Putman, Will. McGrath Biomass Resource Assessment. Tanana Chiefs Conference, Forestry Program, March 2011.

McGrath Biomass Resource Assessment, 2011 Conclusions

Resource Potential

- **Annual allowable harvest**: 10,800 tons (Phase 1) and 44,142 tons (Phase 1 + 2).
- Woody biomass is an **available energy resource** for McGrath, but its **implementation could be challenging** due to the need for detailed planning, limited reference cases, and logistical barriers.

Challenges

Data Limitations: The forest inventory data is extensive but has low field sampling intensity, leading to inaccuracies. Additionally, the data is outdated and doesn't account for recent landscape changes.

Management Concerns and Restrictions: Various concerns, including culturally important sites, subsistence use areas, aesthetic concerns, and operational barriers, can affect biomass resource availability and costs.

Logistical Challenges: Harvesting, transporting, and managing biomass involves significant costs influenced by distances from the village and road access, requiring detailed cost modeling.

Sustainability and Growth Estimates: Determining sustainable harvest levels and growth rates is complex due to varying site potentials, stand densities, and lack of precise growth data.

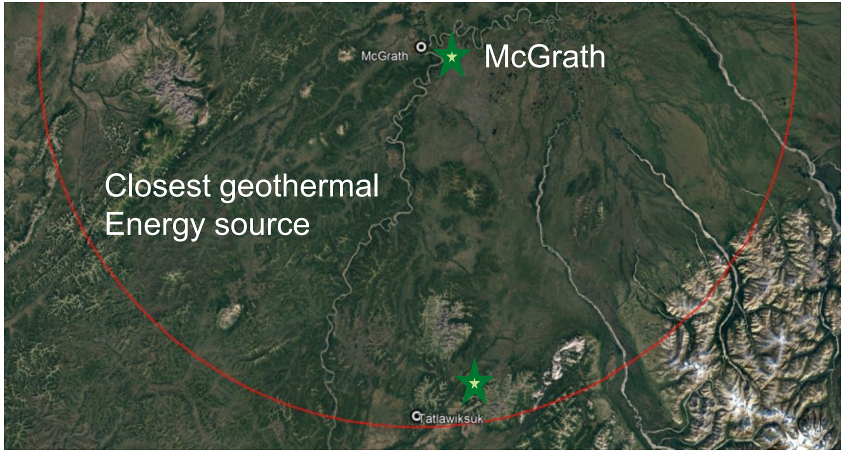
Citation: Putman, Will. McGrath Biomass Resource Assessment. Tanana Chiefs Conference, Forestry Program, Mar. 2011.

Geothermal as an Energy Source

- Geothermal potential has been explored by Alaska Department of Natural Resources. It is viable as an energy source only in certain locations.

Overall, the closest known potential geothermal energy source is 60 miles from McGrath, so the high cost of infrastructure and transmission makes it financially unfeasible.

Geothermal Resource in Tatlawiksuk



- **Location**: The geothermal resource, verified by USGS, in Tatlawiksuk is approximately 60 miles from McGrath.
- **Installation Costs**: High initial costs for setting up a geothermal project and associated infrastructure.
- **Transmission Expenses**: Significant costs to construct a transmission line to connect the resource to McGrath.
- **Feasibility**: Combined installation and transmission costs render the project financially unfeasible at present.

Resource Assessment: Data Gaps

- **Solar Energy**: Estimates of PV generation potential are based on historic weather monitoring for one location. We would ideally have irradiance data besides the one from the airport so if siting is not close to that we can use modeled data.
- **Water Energy**: Additional data collection in progress, targeting run-of-river systems. Implementation faces delays due to low technology readiness level at present.
- **Biomass Energy**: Localized resource assessment hasn't occurred since 2011.
- **Wind Energy**: No site-specific high-quality measurements have been recorded.
- **Geothermal Energy**: No further data needed.

Citation: Putman, Will. McGrath Biomass Resource Assessment. Tanana Chiefs Conference, Forestry Program, Mar. 2011.

Resource Assessment: Take-Aways

Solar and Water Energy identified as future development areas.

- **Solar Energy**: Solar has significant potential for McGrath, benefiting from extended daylight hours in the summer. CEP focus areas pursue a feasibility analysis for solar.
- **Water Energy**: River energy could emerge as a future option, but more research is needed to advance the technology and determine the feasibility of harnessing river currents for energy generation in McGrath. CEP focus areas pursue a feasibility analysis for potential in-river turbines.
- **Biomass Energy**: Resource is potentially available, but barriers (labor, logistics, cost) to developing an industry to effectively harness this resource make it unfeasible for McGrath to pursue at present unless explicitly motivated with community buy-in.
- **Wind Energy**: Lack of resource makes wind energy unlikely for McGrath, though site-specific assessment could better inform potential.
- **Geothermal Energy**: Resource is distant from the demand in McGrath; high infrastructure and transmission costs make this option financially unfeasible at present.

Citation: Putman, Will. McGrath Biomass Resource Assessment. Tanana Chiefs Conference, Forestry Program, Mar. 2011.

Energy Education

4.1 Energy 101

4.2 Hands-On Community Energy Education

4.3 Workforce Development

4.4 Community Decision-Making Workshop

4.5 Funding 101

Energy 101

June 22, 2023 –Virtual Session

Solar and Water Energy identified as future development areas.

The community requested more information about energy systems and renewable energy to better understand the current system and potential renewable energy integration opportunities.

REAP Education Director, Colleen Fisk, presented a virtual Energy 101 session to adults of McGrath. 12 community members were in attendance.

Goal: Introduce the basics of electric grids (parts and how they work), microgrids (types and definitions) and renewable energy technologies

Participants learned about electrical generation and distribution, as well as the pros and cons of wind, solar, hydro, geothermal and battery energy storage options. This laid the foundation for future conversations regarding McGrath's resource assessment and feasibility study.

Citation: Putman, Will. McGrath Biomass Resource Assessment. Tanana Chiefs Conference, Forestry Program, Mar. 2011.

Hands-On Community Energy Education

August 1-4, 2023 – McGrath, AK

With the community's goal of better understanding energy systems and renewable energy, they organized multiple in-person activities to reach a wide audience. REAP hosted a hands-on energy education week where more than 50 adults and 20 children participated in various in-person events. NLR and ANTHC staff were also present to provide technical expertise.

Goal: Assist the community in better understanding electricity, how the grid works, renewable energy, and energy efficiency.

Activities: Hydrokinetic turbine demonstration, energy expedition walk, solar bug activity (pre-k through 5th grade), solar rover activity (5th through 12th grades), family electricity measuring lab.

These activities brought the lessons of Energy 101 to life with hands-on experiments that demonstrated types of electricity generation, efficiency, and systems in their own community. The education focused on topics that had come up during the community energy planning process.

Workforce Development Workshop

November 30, 2023 – Virtual Session

Solar and Water Energy identified as future development areas.

The community requested to learn more about careers in renewable energy and energy efficiency and how residents can pursue these careers. This session was for adult and high-school audiences and open to any community members.

REAP's Alaska Network for Energy and Education (ANEE) distributed a Workforce Assessment survey and lead a virtual work session on Workforce Development to the McGrath Energy committee.

Goal: Keep training local and create visibility of workforce development needs.

The survey respondents and attendees were largely involved in city council, city administration and/or education, with a minority of respondents involved in wildlife, forestry, and maintenance/contracting. The assessment pinpointed tourism, skilled trades and infrastructure maintenance, social services, and childcare as areas of workforce need in the community, with most respondents wanting to direct training resources toward equipment operation and maintenance, construction and carpentry, computer/IT/administrative skills, and plumbing and heating.

Citation: Putman, Will. McGrath Biomass Resource Assessment. Tanana Chiefs Conference, Forestry Program, Mar. 2011.

Community Decision-Making Workshop

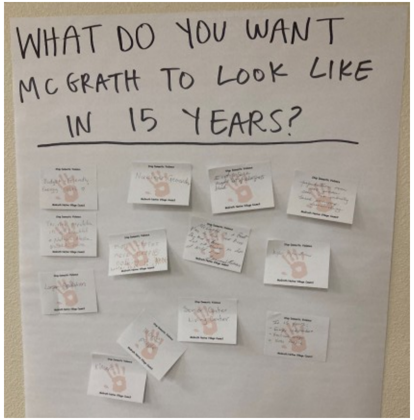
Day 1: January 16, 2024 – McGrath, AK

The community wanted to better understand how informed energy decisions are made. REAP staff (along with NLR, TCC, MTNT) hosted a decision-making workshop on energy priorities to help members of the community think through all the facets of energy decision-making.

Goal: Work with community members to engage on energy goals and priorities.

30 residents attended for a potluck, discussion, and training session. Contributors presented on the baseline energy assessment for McGrath and methodology for generating community energy plans. Community members participated in exercises to express their questions and interests.

Citation: Putman, Will. McGrath Biomass Resource Assessment. Tanana Chiefs Conference, Forestry Program, Mar. 2011.



Community Decision-Making Workshop

Day 2: January 17, 2024 – McGrath, AK

The energy team, community leaders, MTNT, and moderators (REAP, NLR, TCC) met to discuss priority topic areas and develop action items to address McGrath's energy plan.

Goal: Work with the McGrath Energy Committee and local stakeholders to engage on energy goals and priorities.

Participants came up with a list of eight energy priorities, short- and long-term goals for the community. This workshop generated the focus areas for the McGrath Community Energy Plan.

Photo from REAP

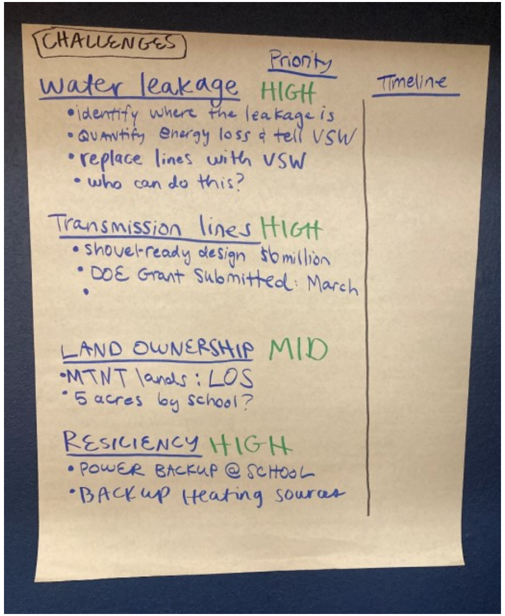


Photo from NLR

Funding 101

August 8, 2024 –Virtual session

The McGrath Energy Committee requested an overview of funding available and strategies for the projects in their CEP. These strategies would include how to make going after funding as straightforward as possible.

REAP staff hosted a Funding 101 session virtually with representation from:

- U.S. Department of Agriculture
- Bureau of Indian Affairs, Alaska Office
- Denali Commission
- Tanana Chiefs Conference
- Alaska Network for Energy Education and Employment
- Alaska Center for Energy and Power
- Alaska Native Tribal Health Consortium

Goal: Introduce funders to the McGrath Energy Committee. Discuss McGrath's energy priorities and goals with funders to determine if their programs may match the community's needs.

Specific programs were identified based on the community's priorities. The representatives also provided tips and tricks for applying to funding opportunities within their programs and generally. Reps from funders and partners became aware of McGrath's funding needs and projects for future opportunities.

Citation: Putman, Will. McGrath Biomass Resource Assessment. Tanana Chiefs Conference, Forestry Program, Mar. 2011.

Community Focus Areas for McGrath Energy Plan

5.1 Distribution System Upgrades

5.2 Solar & Battery Analysis

5.3 River Energy Analysis

5.4 School / Emergency Center Resiliency

5.5 Housing Energy Efficiency & Weatherization

5.6 Water Loss as Energy Loss

5.7 Consideration of a Community IPP

5.8 Funding Strategies & Targets

Distribution System Upgrades

Providing a status report on McGrath's electricity distribution system

Contributors

Lewis Egrass, ML&P
Haleigh Reed, REAP
Rob Jordan, REAP
David Martinez-Biro, NLR
Nathan Wiltse, NLR

Focus Area Background: Distribution System Upgrades

- Since 2019, MTNT has incorporated goals in its Strategic Plan to upgrade ML&P's power plant and distribution system to improve fuel-efficiency, redundancy, stability, safety, reduce operating costs, and support possible future integration of localized energy generation and storage resources.
- McGrath faces high electricity prices and seeks to explore alternative, more affordable energy sources.
- Upon constructing and commissioning the new Power Plant in 2021, ML&P developed a shovel-ready project to upgrade the grid's distribution system ready to deploy upon availability of funding.
- The project to upgrade the distribution lines and other electrical components of the grid is a high priority for the utility and village for modernization, efficiency, and reliability.
- ML&P's distribution lines are an antiquated system constructed circa 1960's & 70's. The 2400V-delta distribution voltage is non-standard, incompatible with certain modern grid edge uses; replacement transformers are expensive and difficult to obtain; and some components are no longer manufactured making repair, replacement, and upgrades challenging or impossible.

Photo from REAP

Distribution System Upgrades

- The new proposed distribution will be 12.47/7.2kV, three-phase, 4-wire overhead distribution designed and constructed in accordance with RUS Bulletin 1728F-804.
- Upgrading the distribution system will help decrease line losses, improve energy efficiency, reduce operating costs, and support possible future integration of renewable energy resources.
- The distribution system upgrades are recommended before new technology is accessed and integrated within the existing grid/energy system.
- The distribution upgrade project is shovel-ready and the electrical distribution design and regulatory permitting is 100% complete. An engineering firm completed the final engineering design drawings, staking sheets, specifications, and cost estimates for the proposed distribution upgrade project.
- MTNT continues to seek and apply for federal funding for ML&P's distribution system upgrade project. Once funded, MTNT is ready to begin procuring long lead items and preparing the Invitation to Bid for the construction contractor to complete the project.
- Most importantly, the upgrades will improve Human Health and Safety by ensuring a reliable source of power for critical infrastructure.

Citation: Putman, Will. McGrath Biomass Resource Assessment. Tanana Chiefs Conference, Forestry Program, Mar. 2011.

Continuing Discussion: 9/27/2024

- **People are leaving McGrath due to high cost of essential goods and services.**
- **Distribution upgrades are related to and should be planned with consideration for current and potential future sources of electricity generation.**
- **Distribution upgrades are critical for health and safety.**
  - Examples of challenges when system is weak / unreliable: Circuit boards burn out, medical equipment in homes, toll on POS register systems at the store, communications, streetlights, infrastructure, water and fire hydrants
  - Emergency response vehicles are plugged in and in heated garages – they would potentially cease to operate and serve their purpose
  - How does the airport plan for back up power during outages? should be further investigated
  - A significant portion of homes do not have wood heat – important if other heat sources go down
  - Impact on sewer and sanitation: homes have 500 gal holding tanks; once full, a pump is activated to transfer to city sewer lines. Then, pumps in main line move sewage to the lagoon. Main line could freeze during prolonged outage.
  - The school locks down during power outages. Will a backup generator transfer switch be on the in- and outside? Distribute "how system works" after install (summer 2025) for emergency preparedness.

With remaining ETIPP funds, McGrath Energy Committee has decided, with MTNT support, NLR will conduct additional analysis November '24 – January '25: Grid Analysis to Understand McGrath Grid Performance, Stress Points, and Renewable Integration Strategies

Citation: Putman, Will. McGrath Biomass Resource Assessment. Tanana Chiefs Conference, Forestry Program, Mar. 2011.

Focus Area:
Solar & Battery Analysis

Exploring the feasibility and potential systems for energy integration

Contributors
Edward Dellamary, TCC
David Martinez-Biro, NLR

Focus Area Background: Solar & Battery Analysis

- The solar photovoltaic (PV) and battery energy storage system (BESS) analysis for McGrath was prioritized because the resource assessment showed high potential for solar energy.
- The McGrath Energy Committee sought options for sizing a PV system that could meet their energy needs.
- McGrath's utility is planning to upgrade the grid, and the McGrath Energy Committee emphasized that they want the grid upgrades completed before any solar energy implementation.
- Ensuring that the grid can handle additional energy capacity was a key consideration in making solar energy a focus area for McGrath.

Introduction to Solar PV + BESS Sizing

Analysis Overview:

- Conducted using NLR's REopt tool, described in the following slides
- Connected with community members to gather the available data for analysis
- Missing data sourced from publicly available internet resources and discussed with community members for refinement when needed

Energy Integration Assumptions:

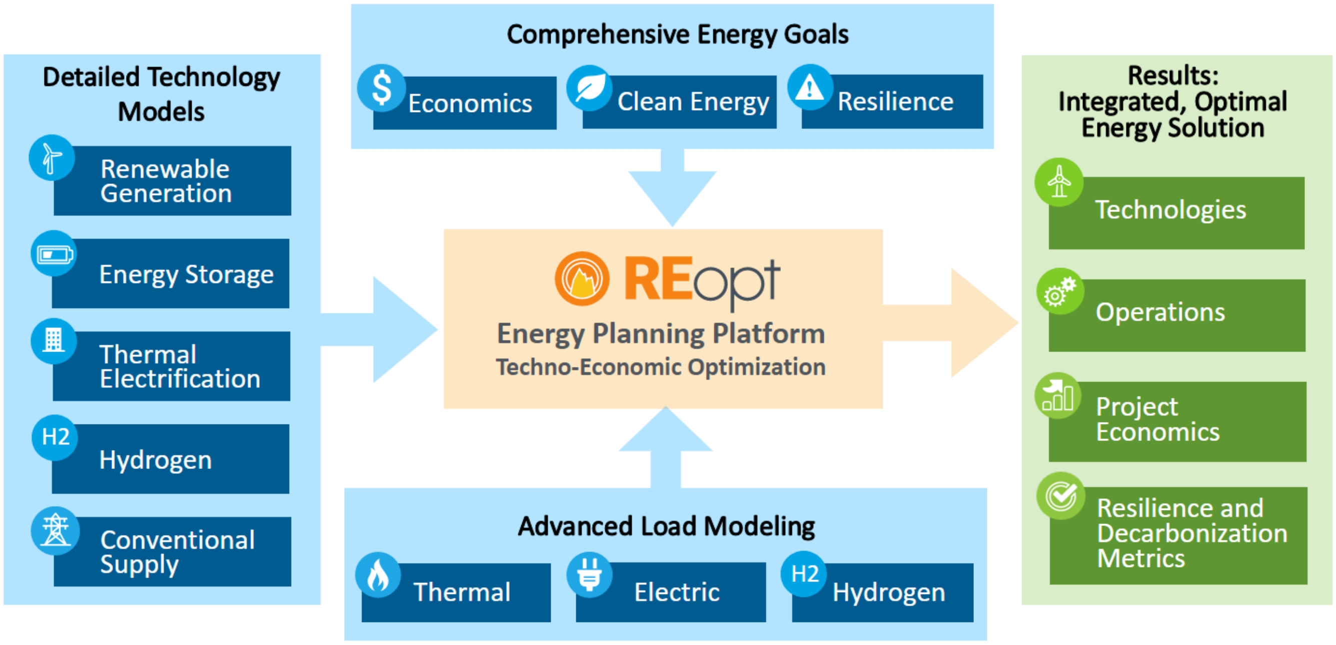
- Integrating either a PV-only or PV + battery system into the McGrath electrical grid requires additional energy management systems, regardless of whether the grid is upgraded.

Key Points:

- Detailed evaluation of solar PV and battery energy storage system (BESS)
- Focus on optimizing system size, cost, and resilience against outages
- Aim to support community energy resilience and sustainable development

NLR's REopt Energy Planning Platform

The REopt model identifies the cost-optimal system sizing and dispatch of integrated distributed energy systems for microgrids to meet a site's energy cost savings and resilience goals.



Results: McGrath System Sizing

<u>Two scenarios were analyzed based on distinct objectives – optimizing for financial cost or system resiliency</u>

Scenario 1: Financial Optimization (No Resiliency)

Focus: Minimize costs under normal grid conditions, focusing on routine energy demands without considering outages (electrical interruptions).

Scenario 2: Resiliency Optimization (2-hour Storage)

Focus: Find the optimal system size while ensuring 2 hours of backup power for operational continuity during outages. The battery sustains critical loads while the generator transitions online, supporting key activities like fuel transport and equipment startup.

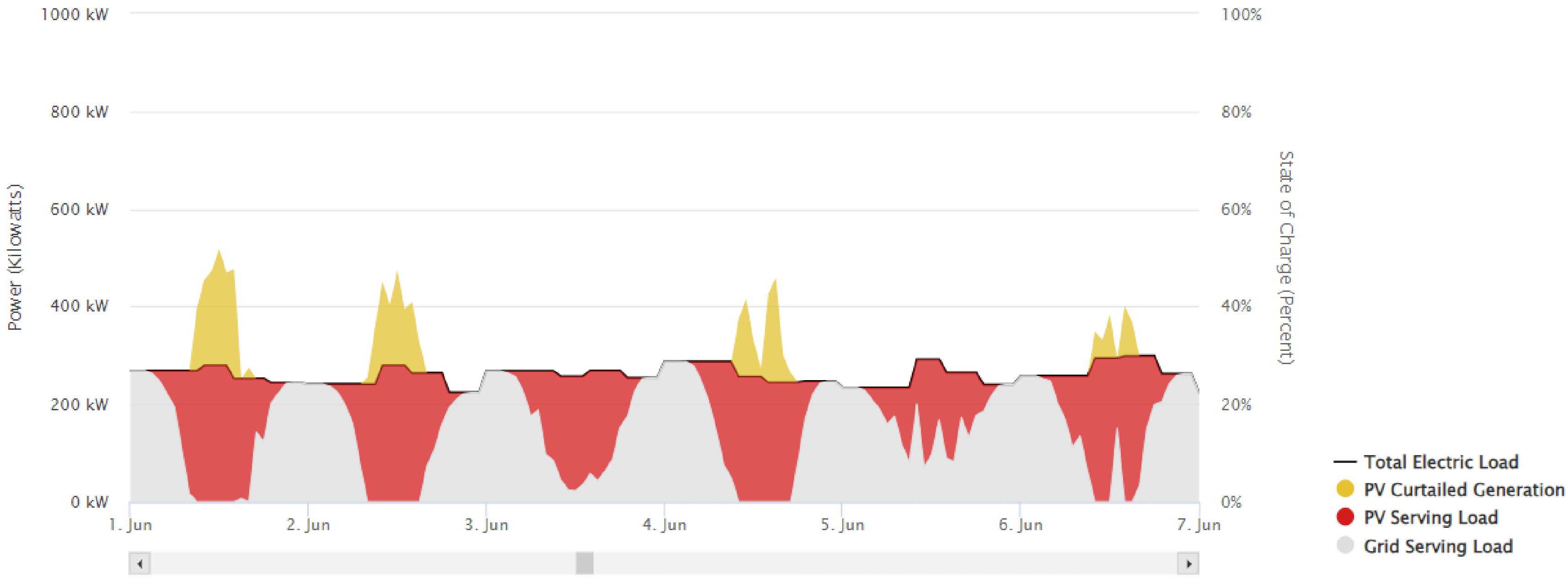
Scenario 1: Financial Optimization

Main Inputs[1]	**Value**
Electricity Rate[2]	0.65 c/kWh
Yearly Electricity Consumption	2,319 MWh
Electricity Cost Escalation Rate	2%
DC to AC ratio	1.3
PV Cost	4.5 USD/W
O&M Cost	30 USD/kW

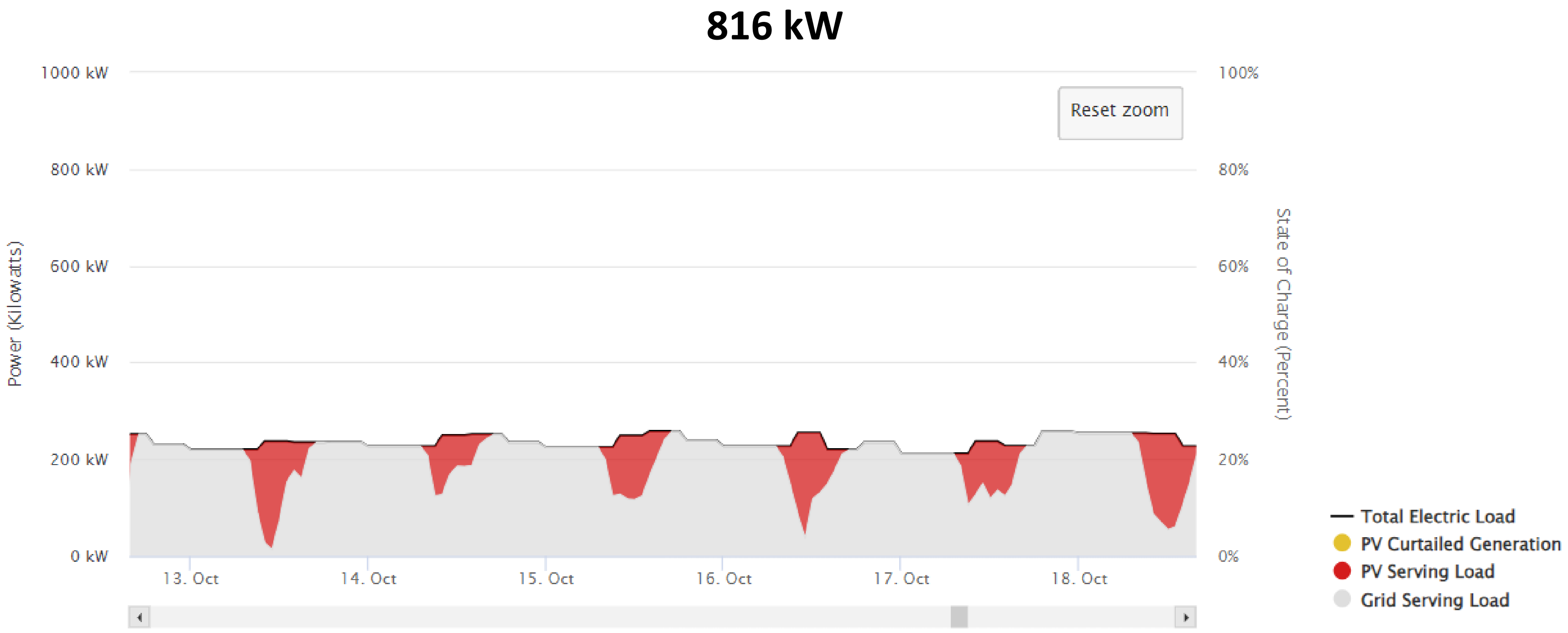
Results	**Value**
PV System Size	816 kWdc
Average Annual AC energy	694,501 kWh[3]
LCOE (PV) = Levelized cost of energy	26.1 ¢/kWh
Payback period	6.45 yr
Total system cost[4]	$3.6M USD

1 Portion of electricity rate that could be reduced with localized energy generation.
2 Around 19% curtailed.
3 Before incentives.

Scenario 1: Solar Energy (June)



Scenario 1: Solar Energy (October)



Scenario 2: Resiliency Optimization (PV+BESS)

Inputs	Value
Electricity Rate[1]	0.65 c/kWh
Total Electricity Consumption	2,319 MWh
Electricity Escalation Rate	2%
DC to AC ratio	1.3
PV Cost	4.5 USD/W
PV O&M Cost	30 USD/kW
BESS Cost	0.9 USD/W / 1.8 USD/Wh
Energy / Power capacity replacement cost	0.6 USD/W / 1.4 USD/Wh

Inputs	Value
Electricity Rate[1]	0.65 c/kWh
Total Electricity Consumption	2,319 MWh
Electricity Escalation Rate	2%
DC to AC ratio	1.3
PV Cost	4.5 USD/W
PV O&M Cost	30 USD/kW
BESS Cost	0.9 USD/W / 1.8 USD/Wh
Energy / Power capacity replacement cost	0.6 USD/W / 1.4 USD/Wh

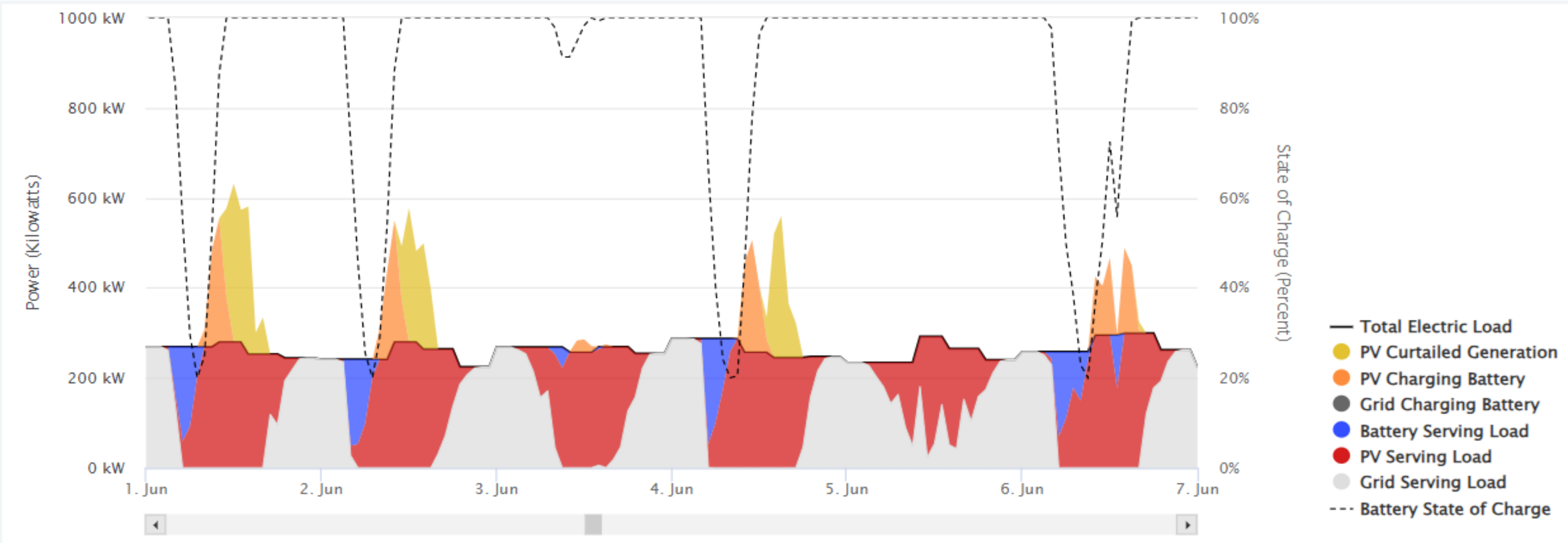
[1] Portion of electricity rate that could be reduced with RE generation

[2] Around 15% curtailed.

[3] Before incentives

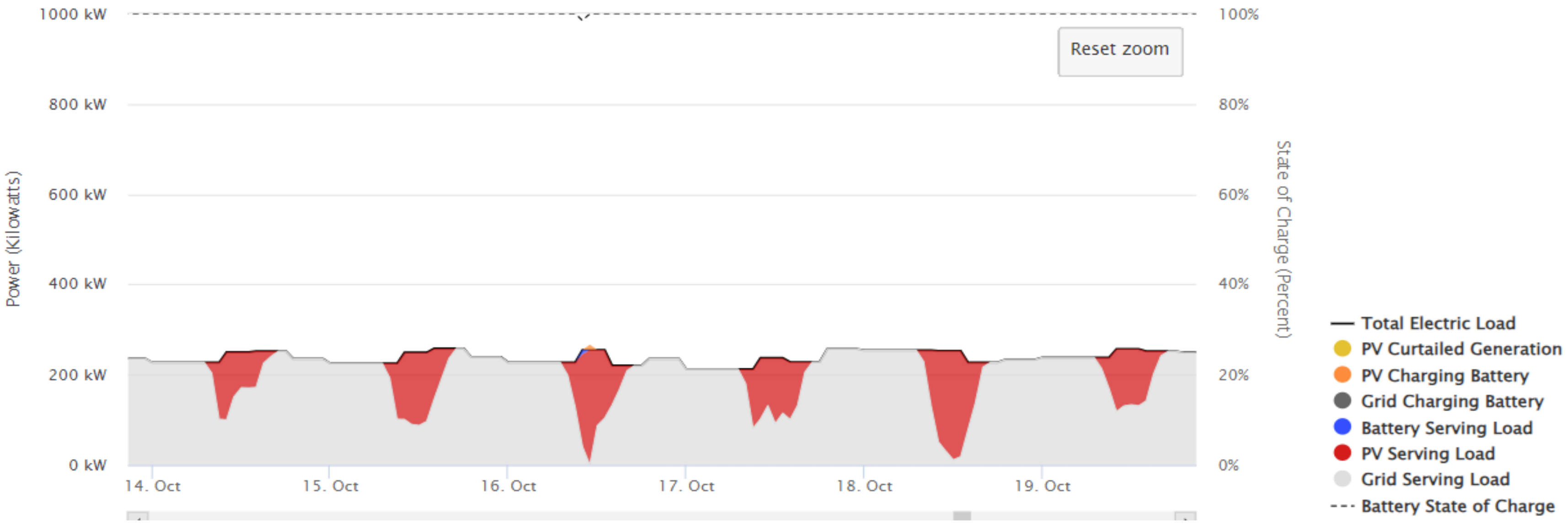
Scenario 2: PV + BESS (June)

994 kW PV + 399kW / 742 kWh



Scenario 2: PV + BESS (October)

994 kW PV + 399kW / 742 kWh



Comparison of Scenario 1 vs 2

Results	Scenario 1	Scenario 2
PV System Size	816 kWdc	994 KWdc
Battery Size [2 hr storage]	NA	399 kW / 742 KWh
% Annual Renewable Electricity	24%	31%
LCOE (PV) = Levelized cost of energy	26.1 ¢/kWh	26.1 ¢/kWh
Payback period	6.45 yr	8.01 yr
Total system cost[3]	$3.6M USD	$5.8 M USD

Explanation of Scenario 1 vs 2

- **PV System Size**: Scenario 2 has a larger PV system (994 KWdc) compared to Scenario 1 (816 KWdc), providing greater renewable energy capacity.
- **Battery Integration**: Only Scenario 2 includes a Battery Energy Storage System (399 kW / 742 KWh), enabling energy storage and increased grid flexibility.
- **Renewable Electricity Contribution**: Scenario 2 provides a higher percentage of annual renewable electricity (31%) compared to Scenario 1 (24%).
- **Payback Period**: Scenario 1 has a shorter payback period (6.45 years) compared to Scenario 2 (8.01 years), primarily due to the higher system costs in Scenario 2 from the inclusion of the battery.
- **Total System Cost**: Scenario 2 is more expensive at $5.8M USD compared to $3.6M USD for Scenario 1.
- **PCE Consideration**: Power Cost Equalization (PCE) does not impact the financials estimated in this analysis. We assume the savings from the system will be applied directly to the community. An Independent Power Producer (IPP) or Power Purchase Agreement (PPA) will need to be established.
- **Levelized Cost of Energy (LCOE):** Both scenarios show the same LCOE of 26.1 ¢/kWh for PV energy because the calculation only considers the PV energy used directly when it is generated. This excludes the energy stored and later used from the battery in Scenario 2, which would likely increase the effective LCOE for stored energy due to additional costs from battery storage and conversion inefficiencies. Hence, while both scenarios show the same LCOE for real-time PV usage, the total cost of energy in Scenario 2 would be higher when accounting for the stored PV energy.

REopt Analysis Conclusions

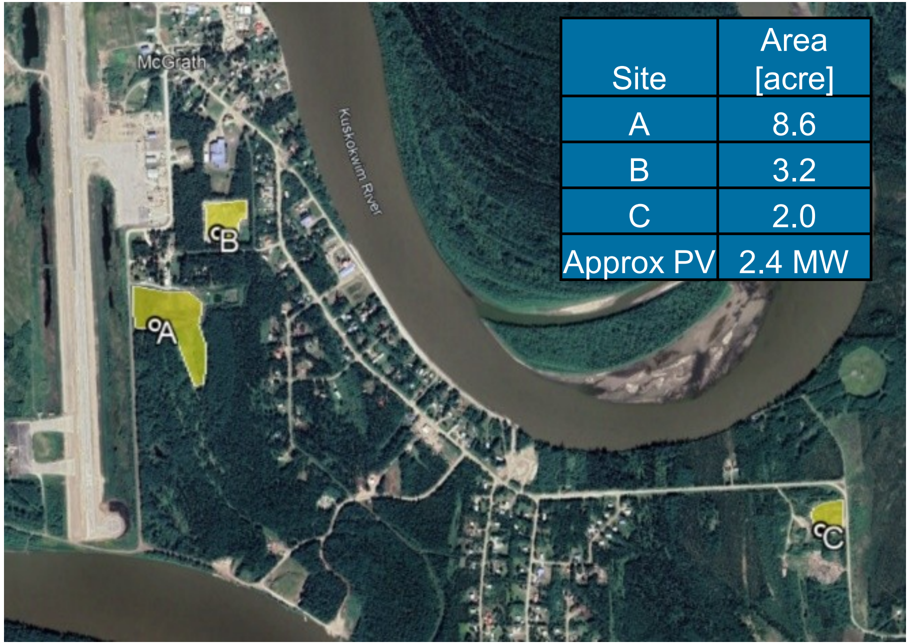
Key Findings:

- **PV + BESS System Options**:
  - Enhance community resilience against outages.
  - Support increased generator capacity.
  - Require thorough analysis of the current grid state before implementation.

Implementation Considerations:

- Current low voltage of the grid necessitates careful matching of system output.
- Integration demands strict controls to manage PV, BESS, and diesel generation.
- Upgraded grid infrastructure will alter voltage, necessitating reevaluation of microgrid operations.

Potential PV System Siting



Site	Area [acre]
A	8.6
B	3.2
C	2.0
Approx PV	2.4 MW

- These sites were selected based on satellite imagery, focusing on areas close to McGrath and clear of trees to simplify installation.
- A fourth site was discussed but ruled out due to flooding / land ownership concerns upon a visit to the site which included members of the community and ETIPP team; Site A may have concerns for helicopter traffic (mixed ownership BLM/state); Site C concern with incinerator proximity & insufficient interconnection point
- These are preliminary selections; final site choices should include a thorough due diligence of land ownership and availability for long-term use.

Community Discussion

- **PV Integration in the Current System**: McGrath's current grid can integrate PV and a Battery Energy Storage System (BESS) without requiring immediate grid upgrades. While the grid operates at a lower voltage and some infrastructure is older, the current setup can handle PV integration. By adding PV, diesel consumption can be reduced while maintaining the same energy flow across the system, helping the community transition toward renewable energy without overloading the grid.
- **Relevance of Grid Upgrades**: While grid upgrades are not immediately required for PV integration, the community has expressed interest in modernizing the grid infrastructure. These upgrades would enhance the grid's long-term resilience and efficiency, making it more adaptable to future increases in renewable energy and improving overall reliability.
- **Energy Management System (EMS)**: An Energy Management System (EMS) would be essential to ensure that renewable generation from PV is smoothly integrated into the grid, managing variable energy and avoiding issues like overloading. The EMS can also curtail excess energy if needed by automatically reducing PV output or storing energy in the BESS.
- **Lifespan/Decommissioning & Disposal**: This has been raised as a priority and needs further development.
- **IPP:** Further clarification necessary on IPP structure and benefits to the community.

Decommissioning and Disposal

Follow on work should address questions and develop a plan.

- **Community Question: Can panels be reused (shed roofs, fences)?**
  - Approximately 95% of solar panels used in the U.S. are silicon-based rather than thin-film.
  - While there's community interest in toxins and disposal, choosing EPA-certified panels as **RCRA Universal Waste** helps reduce concerns, making handling and recycling safer and more manageable.
  - Panels get taken out of the community system if they are hurting efficiency but may be used for less consequential applications.
  - Panels can be used for roofing or siding for a woodshed, sides of a raised bed garden, coffee tabletop, desktop. Optimistically 40 years of life out of them.
    - Information from Rich Stromberg, at ACEP; willing to present to McGrath on reliability testing and independent ratings
  - Elan to send more information (ADEC)
- **Cost of disposal by backhaul may need to be planned for solar and/or BESS development**
- **Community Question: If not reused, what will disposal mean for the landfill?**
  - Class 3 Landfill, unlined, limited space / currently full; Panels should remain intact or hazardous materials could be extracted and shipped out and the rest crushed before wasted locally
  - City would need an estimate of volume; there is a disposal fee per cubic foot

Direct Guidance from AK Department of Environmental Conservation[1]

Solar panels can be disposed of in McGrath (at discretion of the permit holder, the City of McGrath) in two ways:

1. (Preferred) – Covered storage and backhaul to an electronics recycling facility in Anchorage (Central Recycling Services) or Fairbanks (Green Star). This would likely need to be done by barge and could be expensive due to the bulky nature of solar panels. This is the preferred method due to the small amounts of cadmium (only if thin film, less common) and lead contained in solar panels that are better recycled than buried in a landfill where they could potentially leech into the surrounding environment. Some solar panels are considered hazardous waste, and some are not, even within the same model and manufacturer. EPA is undergoing a rule-making process right now to see if solar panels should fall under its Universal Waste laws, which would allow the handling and shipping of these materials to be much easier. If this project is 30 years out, I would hedge that solar panels will be classified as universal waste by the EPA.

2. Burial at the McGrath landfill. Depending on the volume, and assuming it is under the 5 tons per day limit per their permit, I see no reason why the solar panels can't be buried at the landfill. The small amounts of lead and cadmium are effectively contained within the panel, and if they are handled carefully and buried separately in a pit away from the other municipal waste, they shouldn't be an issue. Most solar panels aren't considered hazardous waste now, so they wouldn't be excluded under condition 2 of McGrath's permit. Their only consideration would be handling cost and space at the landfill. It should be noted that these panels should not be crushed or burned as they could then release lead (and cadmium if thin film, uncommon) into the environment.

Additional Disposal Resources

Resources specifically tailored to remote locations like Alaskan villages have not yet been developed; expertise to conduct such research / guidance exists within NLR given funding availability.

General lifecycle / circular economy information related to solar can be found in the following:

1. https://www.nrel.gov/pv/pv-circular-economy.html : (nearly) all NLR pubs on the topic

2. International Energy Agency Photovoltaic Power Systems Programme (IEA PVPS) Task 12 – Solar Sustainability – has other resources: https://iea-pvps.org/research-tasks/pv-sustainability/. NLR researcher leads this international group.

Additional information specific to policy analysis related to end-of-life for renewable system components is available as publications, NLR reports, and via linked in. A sampling of them is given next slide.

Disposal Policy Resources

- A Circular Economy for Lithium-Ion Batteries Used in Mobile and Stationary Energy Storage: Drivers, Barriers, Enablers, and U.S. Policy Considerations
- A Circular Economy for Solar Photovoltaic System Materials: Drivers, Barriers, Enablers, and U.S. Policy Considerations
- Unfounded concerns about photovoltaic module toxicity and waste are slowing decarbonization
- U.S. Federal Policy Considerations for the Management of Retired Large Format Batteries
- U.S. Solar System Decommissioning Policies
- Utility-Scale Solar PV Decommissioning FAQ: What Is Solar PV Decommissioning and Why Is It Important
- PV Module Management Across the Value Chain: Key Takeaways from NSF SOLAR Module Management Working Group
- A Circular Economy for Lithium-Ion Batteries Used in Mobile and Stationary Energy Storage: Drivers, Barriers, Enablers, and Policy Considerations
- Regulatory and Policy Considerations for the Reuse and End-of-Life Management of Solar and Batteries in the U.S.
- A Survey of Federal and State-Level Solar System Decommissioning Policies in the United States
- Regulatory and Policy Considerations for the Reuse and End-of-Life Management of Solar and Batteries
- Best Practices at the End of the Photovoltaic System Performance Period

Next Steps: Solar PV + BESS

Next Steps:

- Conduct detailed PV/BESS grid integration analysis.
- Develop and implement integration controls.
- Discuss and develop disposal plans.

Plan for Potential Grid Upgrades:

- Discuss the plan for the grid with the utility (MTNT).
- Coordinate with the utility to ensure compatibility of upgrades.
- Assess the impact of potential upgrades on microgrid operations.

Final Thoughts:

- Successful integration of PV + BESS can significantly enhance community energy resilience and sustainability.
- Ongoing collaboration with community and technical experts is essential for effective implementation.

Implementation Plan & Continuing Discussion, 9/27/2024

- **Need to further discuss disposal plan.**
- **Discuss in detail financials and payback periods.**
  - Emphasize funding opportunities, e.g. Solar for All
- **Continue discussing tradeoffs with distributed solar vs IPP/ utility-owned**
- **More information would be necessary on engineering, financials, business, logistics, etc.**
  - Gather information on similarly sized, planned, operating solar installations in AK. Consider outcomes from MAGPI (microgrids working group), if available.
- **MTNT plans are to upgrade the grid ASAP; additional analysis including integration, new generation, etc. will then take place.**
- **Discuss time scale that the McGrath Energy Committee would realistically consider planning and implementation.**
  - Would other new technologies become competitive over that time?

Focus Area:
River Energy Resource and Siting Assessment

A study requested by the City of McGrath to evaluate the potential for river hydrokinetic energy (RHK) by the University of Alaska Fairbanks

Contributors

Alaska Center for Energy and Power at UAF

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in collaboration with the City of McGrath

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Sarah McClellan

Focus Area Background: River Energy Study

- The City of McGrath identified renewable energy as a top priority as a means to reduce diesel fuel consumption, energy costs, and long-term impacts to the health of their local ecosystem due to the use of fossil fuels.
- The City of McGrath applied for technical assistance from the University of Alaska Fairbanks (UAF) through the US Department of Energy Testing and Expertise for Marine Energy (TEAMER) Program to evaluate river resources in the Kuskokwim River.
- The City would like to host a behind-the-meter demonstration project to evaluate the feasibility of river energy while the utility, McGrath Light and Power (ML&P), a subsidiary of the Alaska Native Village Corporation representing McGrath, Takotna, Nikolai and Telida (MTNT, Ltd.) considers possible microgrid upgrades before renewable energy integration would be possible.
- In collaboration with the City of McGrath Energy Committee and Renewable Energy Alaska Project (REAP), this study being conducted by the research team from the Pacific Marine Energy Center (PMEC) and the Alaska Center for Energy and Power (ACEP) at UAF is still in progress.

River Energy Study

Is there sufficient resource for river hydrokinetic energy (RHK) development?

Aims

- Survey the Kuskokwim River near McGrath
- Fieldwork - summer 2024
  - high water - rainy season (Aug)
  - low water - fall (Oct)
- Measure
  - water speed
  - depth
  - discharge
- Developing 2 models
  - bathymetry & hydrodynamics
- Community surveys & meetings
- K-12 outreach activities
- Public data archive to MHKDR to attract technology developers of RHK

ADCP transects

4 sites of interest (A-D)

River Energy Study

Field Instrumentation

- **ADCP** (acoustic Doppler
  - Measures water speed
- **GPS** (global positioning system)
- **Singlebeam echosounder (SBES)**
  - Maps river bottom (bathymetry)
- **HOBO (pressure sensor)**
  - steel plate mooring on river bottom
  - cabled to shore

ADCP

Photos from ACEP

HOBO

Photos from ACEP

River Energy Study

Preliminary Results

- There are several promising areas with flow speeds exceeding 1.5 m/s in the river reaches near McGrath during the open water season (May-October)
- Community feedback indicated that areas near existing power infrastructure are preferred and that areas of high use should be avoided.
- The research team are still evaluating the modeling results in order to make recommendations on size to meet community demand and suggested locations for any future current energy converters (CEC).

Acknowledgement:
This work is being conducted under a State of Alaska Land Use Permit LAS 35054, a Letter of Authorization to Access MTNT Land provided by McGrath, Takotna, Nikolai and Telida Native Village Corporation signed May 24, 2024, and is funded by U.S. Dep't of Energy TEAMER under Task Order# UAF_OpenWater_McGrath issued June 24, 2024. The University is committed to a policy of non-discrimination (www.alaska.edu/nondiscrimination) against individuals on the basis of any legally protected status.

Recommendations

- Please note, this is an ongoing study. The team are working together to establish an appropriate timeline for the public release of data out of respect for Indigenous data sovereignty on these traditional ancestral homelands that have been stewarded for millennia by the Upper Kuskokwim Athabascan Peoples.
- The UAF research team are awaiting funds for an additional study to evaluate the under-ice river resource potential in winter, when energy demand is highest.

Implementation Plan, 9/27/25

- The ACEP team returned to the community from September 30 to October 4 and received feedback, ideas, or any comments about river energy from community members.
- Team members stayed at the Innoko Lodge during the week and conducted daily fieldwork from the A/C Store boat ramp on Jon Barton's boat.
- Informal pizza night took place at the Innoko Lodge, where community members were welcomed to stop by and chat with the science team.
- Community questionnaires were collected to share information about river use.
- Delivery of final report to the City of McGrath and McGrath Tribal Council estimated for September 2025.

For any questions regarding river energy, please contact Greg, Miki, or Barb at the City Office

Focus Area:
School / Emergency Center Resiliency

Identifying needs of the school to serve as McGrath's emergency center

Contributors
Joyce Turner, Iditarod Area School District
Aaron Cooke, NLR

Focus Area Background: School/ Emergency Center Resiliency

- An important component of the McGrath Energy Plan is emergency resilience, including a place of shelter during a winter power outage, flooding, fire, or other emergency.
- During the decision-making workshop in January 2024, community members identified a gap in the community's resiliency to power outages and emergencies.
- The McGrath School is the designated emergency center for the community but does not have backup power in the event of an outage in the grid.
- This gap was identified as one of the focus areas for the Community Energy Plan. At the next meeting of the Iditarod Area School District Board of Education, the board prioritized a plan to provide backup power to the school so that it can effectively serve its mission as the community's emergency center facility.

Emergency Resiliency Plan Timeline

1/18/24: Decision-Making Workshop makes installation of backup power to school a focus area of the Community Energy Plan

2/24/24: Discussion item was presented at IASD Board of Education meeting, and plan developed to provide backup power with a 35Kw Cummins Onan Genset owned by IASD

4/11/24: Summer Maintenance projects listed by site at IASD Board of Education meeting, including backup power to school.

6/7/24: Summer maintenance in McGrath begins. Building for the emergency generator is started. Foundation is in place.

6/10/24: Electrician contacted for quote on installation of generator to existing school electric system. Engineer consulted.

[Planned] Spring/Summer 2025: Contractor Matt Graham will trench a fuel line, finish construction, and connect to panel with a manual transfer switch.

Iditarod Area School District
PO Box 90, McGrath, AK 99627
(907) 524-1221
www.iditarodsd.org

August 22, 2024

Working with McGrath Light and Power and City of McGrath, Iditarod Area School District has approved a plan to have McGrath School as the Community Emergency Shelter in the event of a catastrophic natural disaster that would affect 75% or more of the citizens of McGrath.

The school can serve as an emergency shelter for two hundred (200) people for twenty (20) days at Forty Below Zero (-40) or during an extended flood which would cover 80% of the town with six (6) inches of water or more.

Submitted to:

IASD School Board

City of McGrath

McGrath Health Center

Implementation Plan, 9/27

- This focus area is fully planned, funded, and nearing completion.
- Matt Graham will be contracted and has worked in McGrath prior.

Focus Area:
Housing Energy Efficiency & Weatherization

Summarizing community input and audits on buildings in McGrath and the related action items

Contributors
April Curiel, Trainee
Renae Egrass, Trainee
Ralph Morgan, Trainee
Milena Coakley, NLR
Haleigh Reed, REAP
Derek James, Sitka Construction Solutions LLC.

Focus Area Background: Housing Energy Efficiency & Weatherization

- Evaluations of housing and energy efficiency were prioritized as a focus area to better inform the community about health impacts and energy costs related to residential buildings in the community.
- Milena Coakley (NLR), Haleigh Reed (REAP), and Derek James (Sitka Construction Solutions, LLC) traveled to McGrath in June 2024 to conduct residential safety and energy surveys (funding provided by CCHRC, Inc.)
- Community members described cold floors, drafts, high heating bills, and back drafting woodstoves.
- In 2024-2025, some McGrath homes will be granted funds to improve health, safety, and well-being through a U.S. Department of Housing and Urban Development (HUD) Healthy Homes Production Grant awarded to the Rural Alaska Community Action Program, Inc. (RurAL CAP). However, the award isn’t sufficient to cover all home energy efficiency improvements and may only be dispersed to homes meeting certain criteria.

Community Input on Housing

- High cost of energy (fuel and electricity) Wood is the preferred heating source in most households
- Cost of shipping anything to McGrath has skyrocketed - a lot of the time shipping is more expensive than the item itself
- City water is expensive!
- Heat recovery ventilators (HRVs) are not popular - last round of installs was in the 90’s
- Freezing bathtub p-traps and cold floors
- Damaged and uneven foundations due to seasonal ground movement and flood damage
- Leaky windows and doors

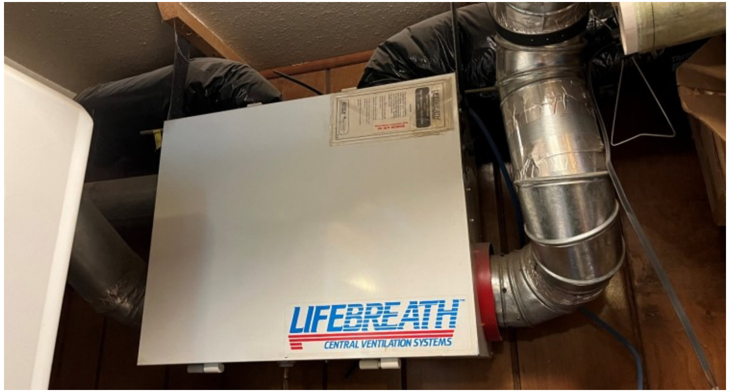
On-site Analysis

- Radon testing is advised for most homes – crawlspace stem walls are tightly sealed with spray foam, there is usually no vapor barrier present, and floors and ground are usually not insulated. No radon data available for McGrath in the Alaska Radon web app.
- Insufficient floor and crawlspace insulation leads to freezing p-traps, cold floors, and significant heat losses.
- Moisture and mold present in some bathrooms / water areas.
- Many foundations are damaged by floods, some are out of level and require adjustment. Alluvial soils along the river are not thaw-stable. None of the foundations we surveyed are easily adjustable.
- Propane leaks are very common and present a health risk.
- Windows accumulate condensation in winter → many are shrink-wrapped.
- Many woodstoves are old and not safe to use.

Photos from NLR

Analysis and Education Parameters

- Breakdowns of Building Energy Efficiency Standards (BEES) Ratings
- Prevalent heating sources
- Who has been left out of the woodstove swap program?
- Water concerns tied into section 4 (Water loss as energy loss)
- Catalytic converter education
- Airtightness/Ventilation, education on ventilation and modern HRVs
- Radon Test Kits available for preliminary data gathering.



Photos from NLR

Next Steps: Housing Energy Efficiency & Weatherization

- Pursue funding to improve health and safety:
  - Radon testing and, if required, mitigation. Short-term radon test kits are available for free from the AK Department of Natural Resources, or for a low fee from the National Radon Program Services. See DNR's Information Circular 90 – Mitigating Radon Levels at Home for testing and mitigation guidelines.
  - Extend woodstove replacement to non-tribal households
  - Repair or replace equipment (lines, stove, regulator, tank, etc.) to prevent or reduce propane leaks
  - Install smoke and carbon monoxide alarms in all households
  - Replace recirculating range hoods and weak bathroom range fans

Pursue funding to increase energy efficiency:

Add insulation to floors, walls, and roofs

Install HRV's (especially in homes with increased air tightness due to other retrofits, i.e., added insulation)

Replace old and leaky windows

Pursue funding to increase resiliency of foundations in case of flooding or differential ground movement.

Make improvements through upcoming HUD Healthy Homes grant

Photo from NLR

Upcoming: Healthy Homes Award

- RurAL CAP HUD Healthy Homes award will be partially distributed in McGrath. The period of performance is through December 2027.
- MNVC will coordinate the award and can freely determine guidelines for the distribution of funds to approximately 20 homes that meet the income limit.
- Up to $10,000 per home to improve health, safety, and well-being according to 8 Healthy Homes Principles.
- Important opportunity with limitations. This program will not address all problems in each household.

Continuing Discussion, 9/27

- There is consensus that increasing energy efficiency in homes through weatherization, audits, and retrofits would improve comfort and energy use.
- However, there's no clear mechanism to do so now, beyond existing HUD Healthy Homes support through RurAL CAP.
- Initiative seems to rest with homeowners.
- Will someone step up to be the local champion?

Focus Area:
Water Loss as Energy Loss

Examining leakage within McGrath's water infrastructure, impacts, and potential solutions

<u>Contributors</u>

Sarah McClellan, City of McGrath

Miki Greenamyre, City of McGrath

Elan Edgerly, ANTHC

Aaron Cooke, NLR

Focus Area Background: Water Loss as Energy Loss

- Reducing leakage and associated excess energy consumption is a high priority to the McGrath Energy Committee. Uncertainty and concerns over the severity of the issue prompted further analysis and made water loss as a CEP focus area.
- The water treatment plant was built in the 1980s with a renovation in 2016-2018. The distribution pipes are from the original construction.
- During a site visit, the water treatment plant operator brought water leakage to the attention of ETIPP technical team.
- Elan Edgerly, Alaska Native Tribal Health Consortium (ANTHC), in coordination with city representatives, conducted an analysis to estimate the energy loss via heating and electricity, due to the water system leakage.

Issue: Water Loss in Distribution Piping

- Water is distributed from the water plant to houses through buried pipes.
- The pipes are leaking at joints.
- As of late 2023, the City estimates 80-90% of the water they made is leaking.
- Raw water comes from the Kuskokwim River and has to be heated, treated, and pumped, all of which have a cost.
- Based on average leak rates, the City incurs an additional cost of **~$73,000** annually, including treatment cost.

Photo from NLR

These costs are partially absorbed by the water utility, leaving them with limited available funding to repair or replace aging infrastructure, potentially threatening their ability to provide water service to the community.

	November 2023	December 2023
Water made (gallons)	1,469,500	2,241,100
Water sold (gallons)	201,600	215,872
Used in washeteria (gallons)	9,240	12,890
% Leaked	**85.65%**	**89.79%**
Average Leak Rate (GPM)	**29**	**47**

Photo from NLR

Energy Costs: Heating

- Raw water is brought in from the Kuskokwim at ~38-42 °F and heated by fuel oil fired boilers to 50-60 °F for storage and distribution.
- This includes the 80-90% of water that is leaked into the ground.
- It is estimated that the City uses an additional 11,322 gallons of fuel annually *just to heat the leaked water.*
- At a fuel cost of $5.47/gallon that is an additional $61,932 cost to the City.

Photo courtesy of the Alaska Native Tribal Health Consortium

Month	January	February	March	April	May	June	July	August	September	October	November	December
Intake Water Temperature	38	38	38	38	42	46	48	54	42	38	38	38
Water Leaked (Gallons)	1,257,900	1,257,900	1,257,900	1,257,900	1,257,900	1,257,900	1,257,900	1,257,900	1,257,900	1,257,900	1,257,900	1,257,900
DelT to replace leaked water (F)	17	17	17	17	13	9	7	1	13	17	17	17
DelT to reheat, no leak (F)	15	15	15	15	13	9	7	1	13	15	15	15
Heat Load with leak (BTU)	177,489,690	177,489,690	177,489,690	177,489,690	135,727,410	93,965,130	73,083,990	10,440,570	135,727,410	177,489,690	177,489,690	177,489,690
Heat Load without leak (BTU)	29,856,760	29,856,760	29,856,760	29,856,760	22,831,640	15,806,520	12,293,960	1,756,280	22,831,640	29,856,760	29,856,760	29,856,760
Fuel used for heating leaked water (gallons)	1,596	1,596	1,596	1,596	1,220	0	0	0	1,220	1,596	1,596	1,596
Additional fuel used (gallons)	1,327	1,327	1,327	1,327	1,015	0	0	0	1,015	1,327	1,327	1,327
Additional fuel cost	$7,261	$7,261	$7,261	$7,261	$5,552	$0	$0	$0	$5,552	$7,261	$7,261	$7,261
Additional Annual Fuel Used	11,322	**gallons**										
Additional Annual Fuel Cost	$61,931											

Photo from NLR

Energy Costs: Electricity

- Because of leaks, the City makes 6-7 times as much water as would normally be required.
- To make the water, raw water is pumped from the river, using a 2 HP pump.
- The distribution system is pressurized using two 7.5 HP, two 15 HP, or one 40 HP pump, depending on flow rates.
- The pump run times are directly correlated to flow rates, which are higher due to water leaks→ Pumps run more often.
- Additional cost to run pumps is estimated at $5,255 per year.
- Plus, more frequent pump replacement
  - Replacement cost for 7.5 HP booster pump: ~$5,500
  - Replacement for 15 HP booster pump: ~$7,000

Photo courtesy of the Alaska Native Tribal Health Consortium

Monthly Values	Pressure Pump	Intake Pump
Required runtime, with leaks (hrs)	163	245
Required runtime, no leaks (hrs)	24	35
Electrical Use, with leaks (kWh)	914	365
Electrical Use, no leaks (kWh)	132	53
Electrical Cost, with leaks	$365	$146
Electrical Cost, no leaks	$53	$21
Additional Annual Electricity Used	13,138 **kWh**	
Additional Electrical Cost	$5,255	

Photo from NLR

Treatment Costs

All raw water is treated prior to being stored and distributed as potable water.

- Treatment chemicals include Calcium Hypochlorite (Chlorinator), Potassium Permanganate (Oxidant), and a Polymer (Flocculant).
- Estimated annual cost: $8,000 at current production levels.
- Estimated $6,800 per year goes to treating water that is leaked.

Photo courtesy of the Alaska Native Tribal Health Consortium

Photo from NLR

Proposed Improvements

- **Repair: The community and VSW secured $3.8 Million for repairs of the water distribution system.**[1]
  - Repair clamps at each fused 3" and 6" joint in the system.
  - Additional isolation valves on water mains.
  - Replacement bushings in service connection.
  - Rehabilitation of existing repair clamps.
  - A force account crew is being assembled by VSW and work is planned to begin in 2024.
- **Replacement: VSW is currently developing a cost memo for the eventual replacement of the distribution system.**
  - A request for $20M has been entered into the Sanitary Deficiency System, which *allows it* – but does not assure it – to be funded by the Indian Health Service.
  - Funding to work on the design to replace the water distribution system will be determined and allocated at the end of calendar year 2024. VSW to coordinate hiring a design firm.

[1] Information on water distribution system status as of 2024, plus ongoing repairs and future support provided by Oscar Menendez, Village Safe Water.

Implementation Plan, 9/27

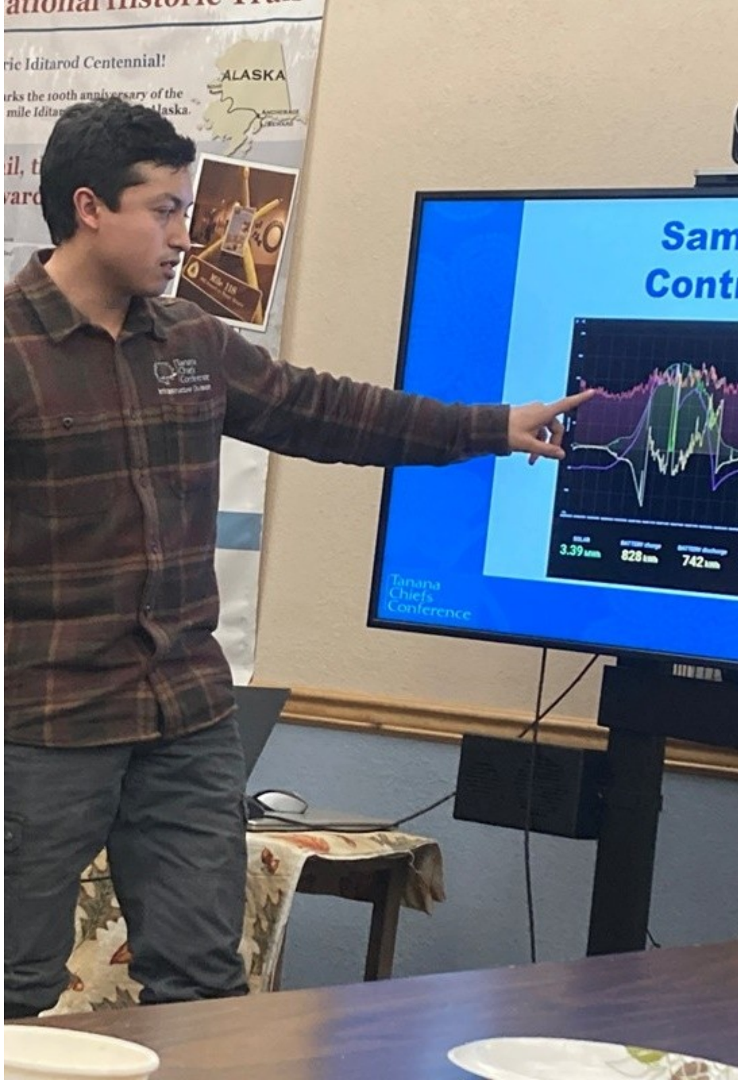
- Updates to system continue, led by VSW. Updates around progress of system repairs were included in the Background Info section, as relayed by Greg Knight.
- Look out for end of year fund announcement for VSW for larger system upgrade.

Focus Area: Consideration of a Community IPP

Understanding pros/cons of establishing an Independent Power Producer to manage a potential renewable system

<u>Contributors</u>

Edward Dellamary, TCC
David Martinez-Biro, NLR
Anne E. Corrigan, NLR
Nathan Wiltse, NLR



Focus Area Background: Consideration of a Community IPP

- New solar / battery energy storage systems (BESS) are rapidly being funded and deployed across the state to reduce diesel consumption and electricity costs.
- Ownership of new renewable energy systems can vary between city, utility, or community, which impacts associated operations, management, and contracts.
- Independent Power Producers (IPPs) are non-utility entities set up to own and operate systems to generate electricity and sell it through power purchase agreements (PPAs).
- IPPs are becoming an increasingly popular solution in Alaska to take advantage of the Power Cost Equalization (PCE) program, which provides financial support to communities and residents of rural electric utilities.
- Optimally, the IPP set up supports utilities to receive PCE credit for purchased energy, keeps revenue in the community under the IPP, and further reduces energy costs to customers while reducing consumption of fossil fuels.

Considerations for IPP vs Utility Ownership

Pros for establishing IPP	Cons for establishing IPP
- Utility is eligible for greater PCE reimbursement; More funds stay within the community - IPP can reinvest revenue into renewable energy expansion, system upgrades, community improvements - Jobs generated (usually part-time), local workforce development - Utility avoids insurance costs - If using a regional IPP structure, can streamline admin and strengthen support network	- IPP is more administratively complex - defining leadership, negotiating PPA, converting benefits to rate reduction - IPP revenue cannot go directly to utility to offset rates - Renewable + storage systems require technical expertise for system integration, operations and maintenance, requiring coordination with utility regardless

Examples of community or Tribal IPPs in Alaska

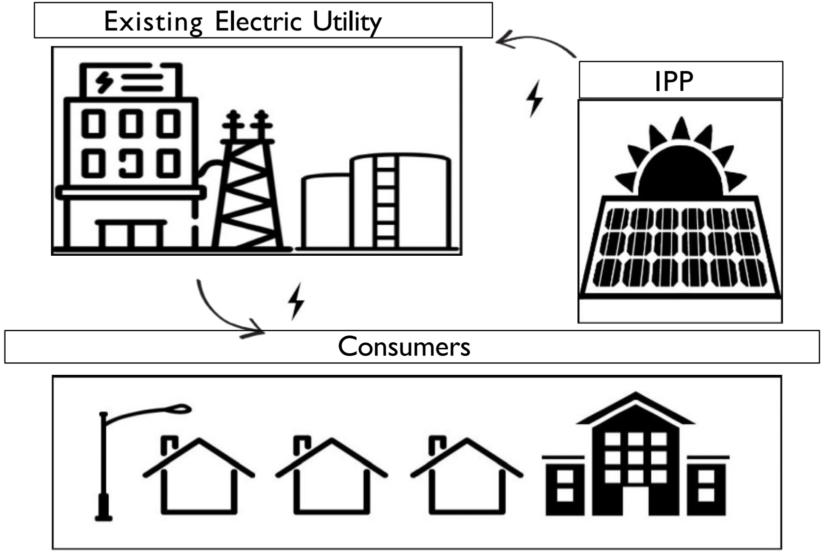
Alaska Village Electric Cooperative (AVEC) has experience evaluating utility-ownership versus IPP setup across different villages and may share insights to inform conversation with MTNT & McGrath

Operating IPPs

- Shungnak-Kobuk
- Noatak

Funded projects with proposed IPPs

- Ambler
- Anvik
- Grayling
- Holy Cross
- Kaltag
- Kiana
- Kivalina
- Minto
- Noorvik
- Nulato
- Selawik
- Shageluk



Example in Shungnak, AK: Divvying up the Cost of Power

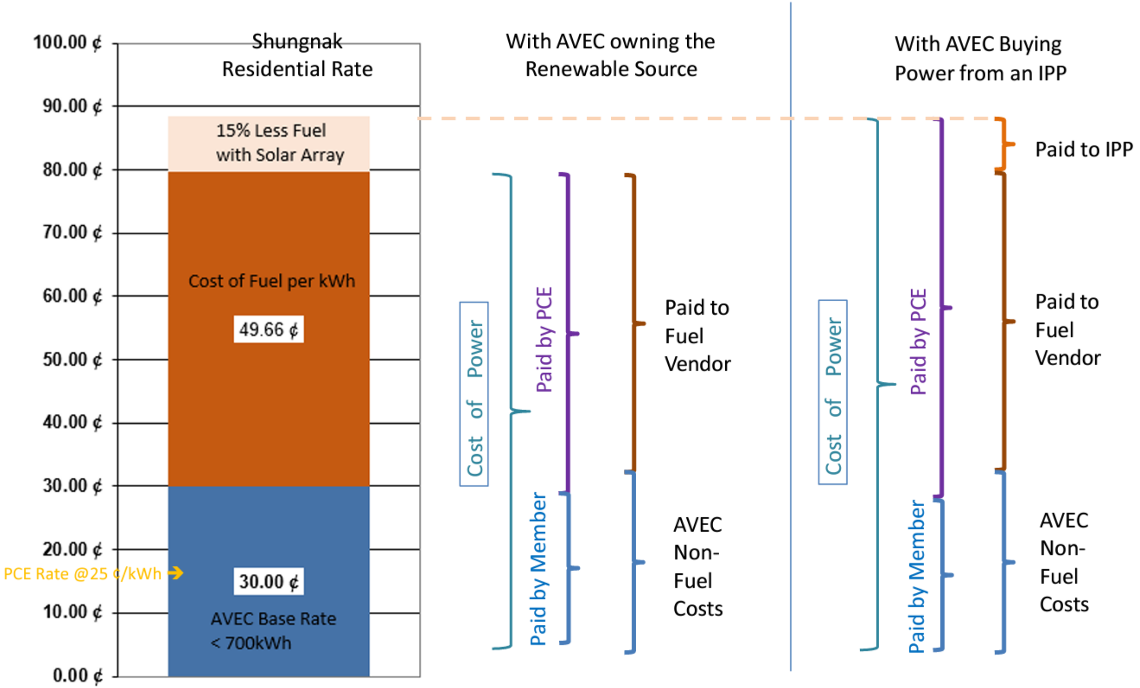


Image courtesy of Alaska Village Electric Cooperative (AVEC), via Ingemar Matthiason, Northwest Arctic Borough

Consideration of an IPP in McGrath

- Stakeholders including MTNT, Ltd (utility), City of McGrath, McGrath Native Village Council (MNVC), and others have discussed the option to set up IPP for new renewable generation and/or storage.
- The City of McGrath has expressed that an IPP is unlikely to be pushed forward by the City without approval of MTNT.
- McGrath could benefit from keeping track of successes and hurdles of other projects in development, considering IPP or utility ownership.
- Other pieces need to fall into place prior to initiating a path to IPP, but it shouldn't be put entirely on the back burner
    - There is some interest in continuing conversations between stakeholders to learn what information is needed
    - Tim will need to educate for an entire week

Continuing Discussion, 9/27

- Still an active area of conversation for the McGrath Energy Committee.
- MTNT is interested in engaging on this topic - or renewable integration more generally - only after the funding for distribution system upgrades has been secured.
- Tim Yoder represented McGrath at the AK Rural Energy Conference and will report back to the Committee.

Focus Area: Funding Strategies & Targets

Once the McGrath Energy Group had settled on the previous seven focus areas of the Community Energy Plan, a strategy to target funding opportunities specific to focus areas in need of further financial support was addressed.

<u>**Contributors**</u>

Haleigh Reed, REAP

Dave Wesolowski, NLR

Distribution System Upgrades

Since 1978, MTNT, Ltd. has owned and operated McGrath Light & Power Co., generating power for McGrath, Alaska via a remote, islanded grid, serving a disadvantaged community of less than 300 residents. During 2020-2021, MTNT built a new power plant building and replaced its generators with four new, fuel-efficient generators as part of the process to upgrade McGrath Light and Power facilities. The next critical step is to upgrade the distribution lines and associated electrical equipment in McGrath which are antiquated, constructed in the 1960's & 70's.

Distribution system upgrades are a high priority for the utility and village for modernization, efficiency, cost-effectiveness and reliability. Plus, upgrades must occur as equipment fails and cannot be replace and before new technology can be integrated with the existing grid/ energy system.

MTNT, Ltd. has developed a plan to upgrade the electrical distribution system to a 7200V grid and is actively seeking funding to support execution of the work.

Distribution System Upgrades

Distributed Energy Systems Demonstration – projects that can demonstrate that aggregated and coordinated distributed energy resources (DERs) can provide reliable, predictable grid services for a wide range of system configurations. 50% cost share. Awards ranging from $10M-$25M. Application closed April 12.

Electric Infrastructure Loan & Loan Guarantee Program - "Insured loans primarily finance the construction of electric distribution facilities in rural areas... ...finance the construction of electric distribution, transmission, and generation facilities, including system improvements and replacement required to furnish and improve electric service in rural areas...". Applications accepted year round.

Denali Commission High Energy Cost Grants - "Funds may be used to finance energy generation, transmission and distribution initiatives." Application window is currently open, application deadline has not been set yet, in years past, deadline has been August 1.

Solar Technologies Rapid Integration and Validation For Energy Systems (STRIVES) - "...design and perform field demonstrations of distribution system operator models that consider technology development and the roles of non-traditional stakeholders in potential distribution electricity services and markets." Application due October 17, 2024.

Solar & Battery Analysis

There are limited centralized data about solar generation in Alaska; however, tools such as PVWatts, by NLR, can estimate solar energy potential at any given location if solar irradiance data is available. Despite lower yearly irradiance, solar remains a competitive energy source in Alaska due to the prolonged daylight during the summer, which significantly enhances solar output, and high electricity prices.

A resource assessment was performed finding solar energy the most economically feasible energy source to reduce diesel consumption in McGrath. A feasibility study was completed based on two scenarios: (1) Solar only: 816 kWdc, no battery system, payback period of 6.45 years. (2) Solar + BESS includes a PV system of 994 kWdc with a battery size of 399 kW/742 kWh and a payback period of 8.01 years.

Integration of new renewable generation with the existing grid is possible but added controls would be required. Nonetheless, the grid upgrade is a high priority for MTNT. Final engineering design and an integration plan for the potential solar /battery system will be required. This could occur with the support of project partners beyond community energy plan development.

Potential PV sites in McGrath, Alaska

Solar & Battery Analysis

Solar for All - To deploy solar photovoltaic infrastructure across the state of Alaska. Program goals are to deploy residential rooftop solar, residential-serving community solar, associated storage, and enable upgrades in underserved communities and low-income households. $125 million was awarded to programs run by the Alaska Energy Authority, Alaska Housing Finance Corporation, Tanana Chiefs Conference, and the Alaska Native Tribal Health Consortium. Applications will open in late 2025.

Energy Improvements in Rural or Remote Areas -- To provide support for rural and remote communities to build clean energy projects that benefit their communities. Program goals include: deliver measurable and sustained benefits to people who live in rural or remote areas (<10,000 people); demonstrate effective rural or remote energy system approaches using climate-resilient technologies; build clean energy knowledge, experience, capacity, and self-reliance in rural and remote parts of America. **7-page concept paper due February 27, 2025**.

Renewable Energy Fund – FY25 Application period now closed. Program is designed to produce cost-effective renewable energy and heat to benefit Alaskans statewide. Applications run through Alaska Energy Authority. For FY25, submitted a capital request of $32M. As of 2023, McGrath has received ~$850K from the Renewable Energy Fund (for heating projects). **Applications usually due in December**.

Solar & Battery Analysis

SOLAR ENERGY EVOLUTION AND DIFFUSION STUDIES 4 (SEEDS 4) – To invest in innovative social science research that generates actionable insights to improve large-scale solar (LSS) siting processes and outcomes for host communities—particularly those that are disadvantaged—and the solar industry. $1M - $2.5M available in funding. Application closed March 15, 2024. **Next opportunity likely 2028**.

Low-Income Communities Bonus Credit Program – Promotes cost-saving clean energy investments.10-20 percentage point increase to the investment tax credit for qualified solar and wind energy projects that are installed in low-income communities or Tribal land. Application window closed June 27, however, after closing date, applications will be accepted on a rolling basis.

River Energy Analysis

The City of McGrath requested Technical Assistance from UAF through the TEAMER Program to explore river energy from the Kuskokwim River.

UAF is conducting fieldwork this summer to measure water speed, depth, and turbulence of the river.
high water measurements: August 26-30, 2024
next trip planned for low water: Sept 30-Oct 4

River reaches to be modelled include: straight sections with high flow, where flow is "smooth" near ML&P power lines.
in front of town and river bend upstream near rock dock
below the airstrip near the ball fields

The results of a hydrokinetic study will be shared with the community, detailing its feasibility as an alternative energy source for the town of McGrath. Data collection is ongoing and scheduled through 2024, with the potential to expand to a winter feasibility study as well. The project also targets community education activities around hydrokinetic technology and community engagement events.

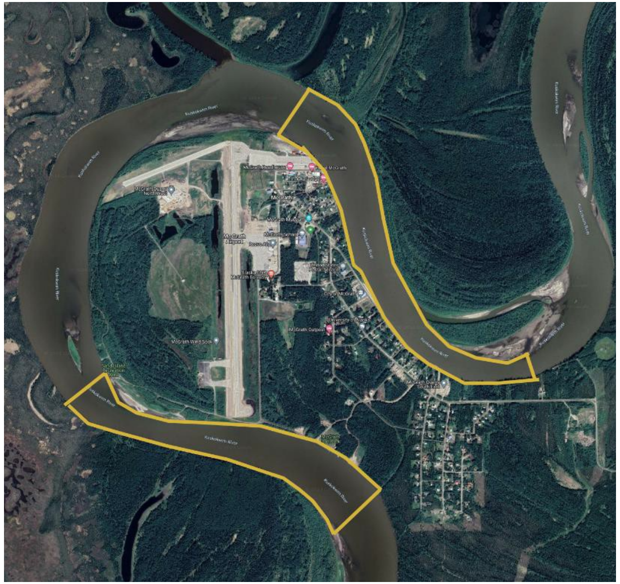


Photo from ACEP

River Energy Analysis

U.S. Department of Energy (DOE) Testing Expertise and Access for Marine Energy Research (TEAMER) - Technical assistance for marine renewable energy (MRE). Applications accepted on a rolling basis year-round, UAF is a pre-approved facility for open-water capability.

Hydropower Technical Collaboration Program - Technical support funding for developing innovative hydropower technologies. Primarily focused on companies. However, applications accepted on a rolling basis year-round. More information on the ORNL website.

Hydropower Testing Network (HyTN) - Application closed August 8. May open again next year. Goal of program is "...to connect hydropower technology developers to testing capability providers."

Strategies to Increase Hydropower Flexibility - Competitive grant for hydropower projects. Focused on 1: hydropower hybrids demonstration 2: technologies to increase flexibility 3: operational flexibility. Awards range $750K - $4M. Application closed May 17.

SOLVE IT - Solutions for Lasting, Viable Energy Infrastructure Technologies prize aims to empower communities to identify and implement innovative clean energy solutions in a way that works for their unique needs and challenges. Application closed April 12. Awards range $80K - $500K.

Housing Energy Efficiency & Weatherization

McGrath has roughly 300 residents[1]. As of March 2023, there were 114 occupied and 77[2] vacant homes in the community. Resident input was taken which identified priority concerns: expensive city water, freezing bathtub p-traps, cold floors, leaky windows and doors. Wood is the preferred heating source in most households.

In 2024, NLR, REAP, and Sitka Construction Solutions LLC went to McGrath for an on-site analysis of 20 homes. Home surveys found many woodstoves are old and not safe to use; radon testing is advised for most homes; insufficient floor and crawlspace insulation led to freezing p-traps and cold floors; leaks in propane were common; and condensation was regularly accumulating on windows.

A HUD Healthy Homes Production Grant through RurAL CAP will be dispersed to begin improving health and safety of households which meet certain criteria. However, the existing funding will not address all problems in each household, making the need for additional funding to improve health, safety, and energy efficiency of McGrath homes imperative.

[1]Estimate provided by Sarah McClellan, prior City Administrator, September 2024
[2]Estimates provided by Greg Knight.

Housing Energy Efficiency & Weatherization

DOE Weatherization Assistance Program Enhancement & Innovation Grants – for state, local, or Tribal governments and 501(c)(3) non-profit organizations to perform deep energy retrofits of low-income residential buildings and empower local community representation within the energy workforce. Current year application deadline was October 11, hopefully re-opens next year.

Energy Efficiency and Conservation Block Grant Program (EECBG) - Large program with formula/competitive grants as well as technical assistance. Funds wide variety of energy efficiency projects. Recent extension of formula grant application deadlines. October 31, 2024 for local governments and May 31, 2025 for Tribes.

Housing Preservation Grants - Funding for rural areas for the repair or rehabilitation of housing owned or occupied by low- and very-low-income people. Current year application closed July 29, re-opens on yearly basis.

Village Energy Efficiency Program (VEEP) - Local governments and Tribes both eligible for program. Seeks to "...implement energy and cost-saving efficiency measures in buildings and facilities in small, high-energy cost Alaska communities." Applications accepted through Alaska Energy Authority. Current year application period closed February 27 and May 28. Re-opens yearly.

Rural Capacity Building for Community Development and Affordable Housing Grants (RCB) - Application closed March 25, re-opens yearly in January. Program purpose is "...to carry out affordable housing and community development activities in rural areas for the benefit of low- and moderate-income families and persons."

Water Loss as Energy Loss

The City of McGrath operates a small water plant which provides piped water and sewer through underground pipes to residents and is not connected to any larger municipal water system. The water plant and associated distribution piping in McGrath was constructed in the mid-1980s. The distribution piping has a history of leaking, however, in recent years it progressively worsened. In 2023, the city reported an estimated leakage of 80-90% of the water they circulate within the pipes. In November and December 2023, they reported an average leak rate of 29-47(GPM); by February of 2024 they reported 55 GPM.

As a result of the extreme cold climate of McGrath, the water distributed must be heated and constantly circulated to prevent freezing. Therefore, every gallon lost to leaks needs to be replaced and heated using fuel-oil boilers. The cost of this additional water heating and demand on the pump for increased circulation is a significant financial burden on the city. As of 2024, McGrath pays $5.47/gallon for fuel and $0.40/kWh post PCE-reimbursements. Conservatively assuming a loss rate of 29 GPM, that results in $61,111 in fuel plus $5,255 in electrical usage annually that is directly tied to the water leaks. If the most recently reported leak rate of 55 GPM is used, then annual costs for fuel and electricity increase to $128,111 and $9,926, respectively. This cost burden potentially stresses the utility's ability to provide reliable access to water which has community health implications. Access to water directly correlates with health outcomes and is proven to have respiratory infection implications to infants[1].

[1]ANTHC Clean Water & Sanitation, https://www.anthc.org/clean-water-and-sanitation/

Water Loss as Energy Loss

State Funding Targets

Community Assistance Program (CAP) – Formula funding for projects "vital to the delivery of public services". Fits multiple needs. FY25 Application closed June 1. Usually re-opens January 31 of following year. McGrath has consistently applied for and received funds through this program. (~$78K FY24, ~$65K FY23, ~$76K FY22)

Village Safe Water (VSW) Capital Improvement Project (CIP) – McGrath has received ~$650K in FY24 funding for "Water treatment plant renovations. Replace STEP septic tanks and lagoon aeration system. Improvements to the piped water". Application period usually opens in mid-February and closes early March. Open for ~ 3 weeks.

Micro Loans for Water, Wastewater, Solid Waste, and Nonpoint Source Projects – Micro loans of up to $500K available, repayment terms of 30 years with subsidies available in the form of principal forgiveness. Funds can be used for project planning, design, construction and energy efficiency improvements. Applications accepted on a rolling basis.

State Revolving Fund – Low interest loans available that can "…finance up to 100 percent of a project's eligible costs for planning, design and construction of publicly owned facilities. In addition, loans can serve as local match for other federal or state funding sources." Specifically for water related projects. Applications accepted throughout year, having an application ready by June gives better chances at being accepted.

Water Loss as Energy Loss

Federal Funding Targets

WaterSMART: Water and Energy Efficiency Grants for FY24 & FY25 – Competitive grant for projects that conserve and use water more efficiently. Awards can be up to $5M. Does have a 50% match component. Estimated 50 awards. **Deadline to apply: November 13, 2024**

Emergency Community Water Assistance Grants in Alaska – Grants up to $1M for construction of new wells, reservoirs, transmission lines and treatment plants. Grants up to $150K for water transmission line repairs, extensions and address related maintenance necessary to replenish water supply. **Applications accepted year-round**.

Water & Waste Disposal Loan & Grant Program in Alaska – Long term, low interest loans for the acquisition, construction or improvement of drinking water, sewage, solid waste and storm water. Up to 40 year payback period. Fixed interest rates based on median area household income and need for the project. **Applications accepted year-round**.

Consideration of a Community IPP

Rural Energy for America Program Renewable Energy Systems & Energy Efficiency Improvement Guaranteed Loans & Grants (REAP) – **Application deadlines of June 30 and September 30, 2024**. Loans guarantees up to 75% of eligible project costs. Grants up to 50% of eligible project costs (match required). Funding for energy efficiency improvements and renewable energy grid infrastructure.

ANTHC Rural Energy Program – Program that works directly with communities to improve sustainability and lower operating costs. Assists with IPP set up. Targets water and sewage infrastructure also. Contact opfeifer@anthc.com and energy@anthc.org

Rural Business Development Grants in Alaska - **FY24 application closed February 28. Re-opens yearly**. Broad range for funds use. Specifically focused on community economic and workforce development. Applications go through AK USDA state office.

Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) Programs – Program "...awards non-dilutive funding to develop your technology and chart a path toward commercialization". Upon receiving federal funds from this program, entities are then eligible for the state program, potentially receiving more funding for business and technology development. **State application closed May 10, re-opens yearly.**

Other Opportunities

Alaska Conservation Foundation Rapid Response Grants – $15K grants for direct conservation action to address urgent or unforeseen opportunities or threats of statewide significance. **Applications accepted on a rolling basis**.

Vocational Fund for Alaska's Future – Workforce development grant program for projects specifically focused on rural communities in Alaska. Grant amounts typically $10K-$50K. **Applications accepted October 1 - November 15, 2024**.

Transportation Housing and Urban Development Congressionally Directed Spending Requests - Through the Southcentral Foundation $2M in FY24 funding was allocated to construct rural health care workforce housing for McGrath, Kokhanok and Nondalton.

Denali Commission Program Grants - **Current year application closed April 12 usually posted in January**. 60 awards with a range of $150K - $2M. Broad range of eligible projects: energy, transportation, general infrastructure and housing, workforce and economic development, etc.

Implementation Plan and Continuing Discussion, 9/27

McGrath Energy Committee would be interested in support from grant writers to go after any of the opportunities presented in this section. First, that requires more information on what grant-writing support takes and, second, requires knowing the options and making connections to set it up.

- Who does it?
- What does it cost?
- How do we get connected with those people around the state?
- Is there more information that would be helpful to navigate the different types of grants?

Thank you

NLR/OT-5600-92491

This work was authored in part by the National Laboratory of the Rockies for the U.S. Department of Energy (DOE) under Contract No. DE-AC36-08GO28308. Funding provided by U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy, Building Technologies Office, Energy Transitions Initiative, Geothermal Technologies Office, Solar Energy Technologies Office, Vehicle Technologies Office, Water Power Technologies Office, and Wind Energy Technologies Office. The views expressed in the article do not necessarily represent the views of the DOE or the U.S. Government. The U.S. Government retains and the publisher, by accepting the article for publication, acknowledges that the U.S. Government retains a nonexclusive, paid-up, irrevocable, worldwide license to publish or reproduce the published form of this work, or allow others to do so, for U.S. Government purposes.

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