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McGrath Community Energy Planning

Energy Technology Innovation Partnership Project (ETIPP)

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About the Community

McGrath is a remote interior Alaska community of 300 people located on the upper Kuskokwim River. The isolated microgrid supporting McGrath is vulnerable and costly, with electric and water utilities that are especially vulnerable. The high cost of fuel is a threat to the community, which has been declining in population since 1990.¹ McGrath is interested in exploring ways to reduce reliance on diesel as the single fuel source. A community improvement survey was conducted in August 2021. Residents identified 13 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 residents’ future, the City is prioritizing the exploration of alternative resilient energy technologies.²

Planning Process

In 2023, the City of McGrath convened multiple groups into a McGrath Energy Committee to begin the ETIPP process. The group includes the following:

- City of McGrath (“McGrath”)
- McGrath Native Village Council (MNVC) – federally recognized Tribe
- McGrath Light & Power (ML&P) - Utility serving McGrath
- MTNT, Inc. - Regional Alaska Native corporation and owner of ML&P
- Iditarod Area School District (IASD).

The McGrath Energy Committee worked with a diverse team of technical experts to develop their Community Energy Plan (CEP). The CEP planning process is outlined in Figure 1.



Figure 1. McGrath’s community energy planning process

Baseline Energy Assessment

The McGrath Energy Committee and a technical team comprising the National Laboratory of the Rockies (NLR), Renewable Energy Alaska Project (REAP), Alaska Native Tribal Health Consortium (ANTHC), Tanana Chiefs Conference (TCC), and the Alaska Center for Energy and Power (ACEP) conducted a baseline assessment of existing infrastructure in the community, reviewing available reports and interviewing key stakeholders. The baseline assessment focused on electrical generation and distribution, heat recovery, and water/sewer system implications on power consumption. Table 1 presents key findings from these four areas of assessment.

Table 1. Baseline Energy Assessment and Key Findings

Assessment Area	Key Findings
Electrical Generation	<ul style="list-style-type: none"> • ML&P built a new power plant in 2020/2021 with United States Department of Agriculture (USDA) High Energy Cost Grant funds. • The updated plant retired antiquated/problematic Caterpillar gensets with four Detroit Diesel Series models that meet U.S. Environmental Protection Agency (EPA) requirements for diesel power generation in remote areas of Alaska. • The gensets are rated to 350 kilowatts (kW). Average summer usage is 240 kW and average winter usage is 290 kW.³ The system alternates between sets to balance load and distribute run time evenly.
Electrical Distribution	<ul style="list-style-type: none"> • McGrath has a 2400-volt (V) system for distribution, which is rare for modern systems in Alaska. • Line losses of 9% and 87% efficiency (consumed vs. generated power). • 166,000+ gallons of diesel are consumed annually for electricity generation (14 kilowatt-hours (kWh) per gallon of diesel). • 191 residential customers in McGrath average 2,577 kWh each in 2023, compared to 4,042 kWh per residential customer in other rural Alaskan communities, which points to effective local conservation measures in McGrath. Rural Alaskan communities in this context are communities eligible for power cost equalization (PCE).
Heat Recovery System	<ul style="list-style-type: none"> • A waste heat recovery system uses excess heat from the power plant. Based on McGrath loads, approximately 400–500MBTU of heat is available to recover, roughly equivalent to ~20–25,000 gallons of fuel per year. • Recovered heat meets the power plant heat loads as well as two loops that serve various commercial and public buildings (two lodges, Village Grocery Store, McGrath School and school district buildings, and clinic).
Water/Sewer	<ul style="list-style-type: none"> • Water and sewer systems are major consumers of fuel and energy, prompting interest to explore their operation and efficiency in the energy focus areas.






Local Energy Resource Assessment

After reviewing the Baseline Energy Assessment, the McGrath Energy Committee directed the ETIPP technical team to conduct a local Energy Resource Assessment. Diesel prices at the pump in McGrath are around \$8.55 per gallon,¹ with costs expected to rise, making it an increasingly unsustainable energy source. The power plant purchased 160,000 gallons of fuel for \$800,000 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.

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. Although micronuclear technology was also discussed, it was omitted from the resource assessment because of its high cost and low technology readiness at this scale. Key findings from the Renewable Energy Resource Assessment in McGrath are listed in Table 2.

Table 2. Resource Assessment Key Findings

Resource	Key Findings
 Solar	Solar has significant potential for McGrath, benefiting from extended daylight hours in the summer. Community Energy Plan focus areas pursue a feasibility analysis for solar.
 Water	McGrath is located on the Kuskokwim, one of the largest rivers in the state. Water power could emerge as a future option, but more research is needed to determine the feasibility of harnessing river currents for energy generation. Community Energy Plan focus areas pursue a feasibility analysis for potential in-river turbines.
 Biomass	Biomass is potentially available but not currently feasible because of cost, labor, and logistics demands.
 Wind	Lack of consistent wind resource makes wind energy unlikely; site-specific assessment could better inform potential.
 Geothermal	Resource is distant from the demand in McGrath; high infrastructure and transmission costs make this option financially infeasible at present.

Energy Education

The community requested more information about energy systems and renewable energy to better understand the current grid and potential renewable energy integration opportunities. Five community energy education events were organized during the project to engage the community in energy issues. The energy education series was organized and facilitated by REAP, which also serves as Alaska’s regional partner in the ETIPP program. Five education sessions were conducted during the project, with topics requested by the McGrath Energy Committee:

- 1. Energy 101:** 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.
- 2. Hands-On Community Education:** 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 arisen during the Community Energy Planning process.

- 3. Workforce Development Workshop:** The community requested more exposure to careers in renewable energy and energy efficiency. This session was open to community members high-school aged and older.
- 4. Community Decision-Making Workshop:** The McGrath Energy Committee, community leaders, MTNT, and moderators (REAP, NLR, TCC) met to discuss priority topic areas and develop action items to address McGrath’s energy plan. Participants came up with a list of eight energy priorities for the community. This workshop generated the focus areas for the McGrath Community Energy Plan.
- 5. Funding 101:** In this virtual meeting, community members heard directly about funding opportunities from representatives of the following organizations:
 - United States Department of Agriculture (USDA)
 - Bureau of Indian Affairs, Alaska Office (BIA)
 - Denali Commission
 - Tanana Chiefs Conference (TCC)
 - Alaska Network for Energy Education and Employment
 - Alaska Center for Energy and Power (ACEP)
 - Alaska Native Tribal Health Consortium (ANTHC).

McGrath Community Energy Plan: Key Focus Areas

At the Community Decision-Making Workshop, the McGrath Energy Committee talked through the results of the Baseline Assessment, the Renewable Energy Resource Assessment, and the Community Energy Education events to date. From those discussions, they created eight focus areas for development of the McGrath Community Energy Plan, shown in Figure 2.

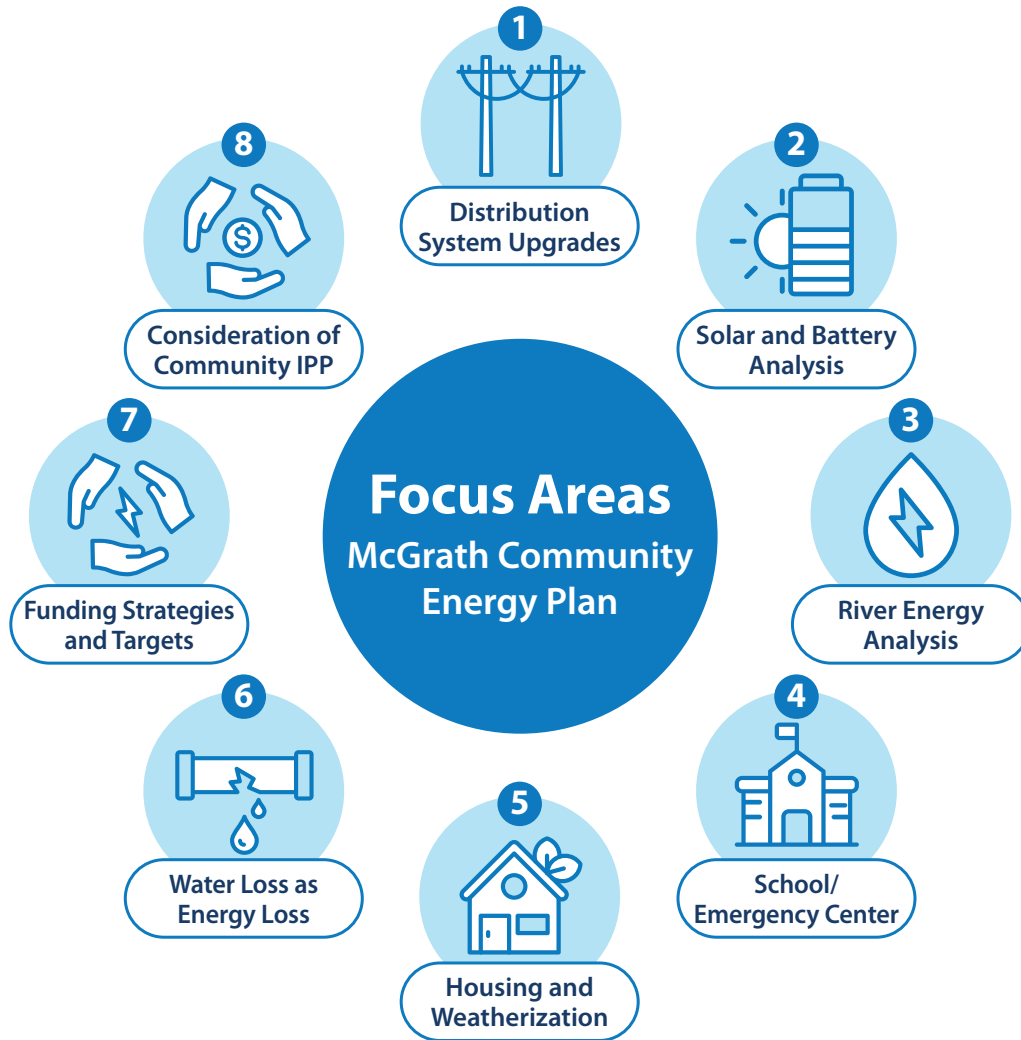


Figure 2. CEP focus areas



McGrath Power Plant Photo by Haleigh Reed, REAP

Focus Area 1: Distribution System Upgrades

Upon constructing and commissioning the new power plant in 2021, ML&P developed a shovel-ready project to upgrade the grid's distribution system 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 city in terms of modernization, efficiency, and reliability.

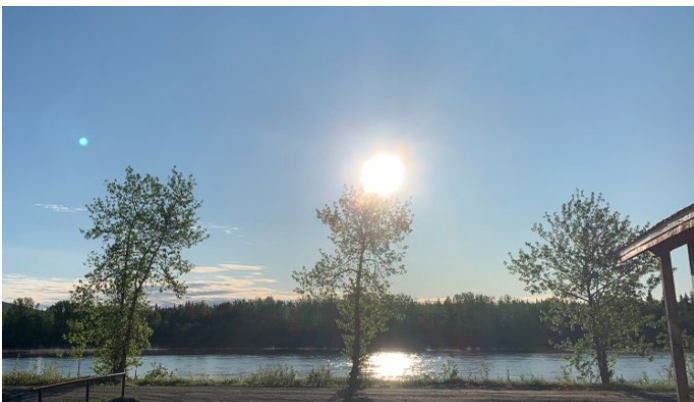
ML&P's distribution lines are an antiquated system constructed circa 1960s and 1970s. The 2,400-V-delta distribution voltage is nonstandard, incompatible with certain modern grid edge uses; replacement transformers are expensive and difficult to obtain; and some components are no longer manufactured — making repair, replacement, and upgrades challenging or impossible. ML&P and MTNT have emphasized they wish to update the grid before integrating renewable energy.



Solar Panels at NLR's Alaska Campus *Photo by Molly Rettig, NLR 69039*

Focus Area 2: Solar and Battery Analysis

McGrath chose to prioritize a solar photovoltaic (PV) and battery energy storage system (BESS) analysis 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. Ensuring the grid can handle additional renewable energy capacity was a key consideration in making solar energy a focus area for McGrath. An analysis overview was conducted using NLR's REopt tool, and missing data were sourced from publicly available online resources and discussed with community members for refinement when needed. Two scenarios were analyzed based on distinctive objectives: optimizing for financial cost or for system resiliency. Potential siting of PV systems was evaluated. Decommissioning and disposal of PV components at end of life was also investigated. Detailed findings are documented on slides 56 through 77 of the Community Energy Plan.⁴



The Kuskokwim River in McGrath *Photo by Haleigh Reed, REAP*

Focus Area 3: River Energy Analysis

A preexisting preliminary resource assessment of water power, including traditional hydropower and marine energy and hydrokinetics, was underdeveloped and limited by lack of data and information.

Learning about additional sources of energy to support reducing fuel consumption and costs made hydrokinetic analysis a focus area for McGrath. The Energy Committee prioritized additional water resource analysis to understand energy potential from the Kuskokwim River, which surrounds McGrath. The Alaska Center for Energy and Power at the University of Alaska Fairbanks (UAF) was funded to conduct a resource and siting assessment for McGrath in 2024, concurrent with energy planning activities through ETIPP.



The McGrath School Assembly Hall *Photo by Haleigh Reed, REAP*

Focus Area 4: School/Emergency Center Resiliency

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 it can effectively serve its mission as the community's emergency center facility.



McGrath Homes Surveys *Photo by Haleigh Reed, REAP*

Focus Area 5: Housing Energy Efficiency and Weatherization

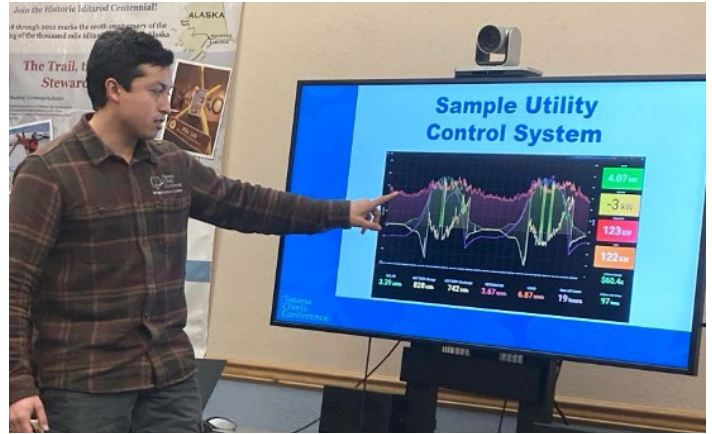
The Energy Committee identified housing and energy efficiency evaluations as a focus area to better inform residents about energy costs and health impacts related to residential buildings in the community. The evaluations were conducted in June 2024 by a team of technical experts from NLR and REAP as well as a private contractor and support from the Cold Climate Housing Research Center (CCHRC, Inc). Community members described cold floors, drafts, high heating bills, and backdrafting woodstoves.



The McGrath Water Plant *Photo courtesy of the Alaska Native Tribal Health Consortium*

Focus Area 6: Water Loss as Energy Loss

Reducing leakage and associated energy loss 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 a CEP focus area. The water treatment plant was built in the 1980s and renovated in 2016–2018, with original distribution pipes still in use. During a site visit, the water treatment plant operator brought water leakage to the attention of the ETIPP technical team. Technical staff from ANTHC, in coordination with city representatives, conducted an analysis to estimate the energy lost because of the water system leakage via heating and electricity. As of late 2023, the city estimates 80–90% of the water it makes is leaking. Based on average leak rates, the city incurs an additional cost of ~\$73,000 annually, including treatment cost and additional fuel used to heat the leaked water.



McGrath Community Planning Meeting *Photo by Aaron Cooke, NLR 104502*

Focus Area 7: Funding Strategies and 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 each focus area was addressed (see Figure 3 and Table 3).



McGrath Community Planning Meeting *Photo by Aaron Cooke, NLR 104500*

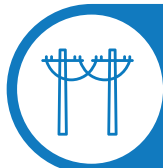
Focus Area 8: Consideration of a Community Independent Power Producer

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 nonutility 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 facilitates utilities' receiving PCE credit for purchased energy, keeps revenue in the community under the IPP, and further reduces energy costs for customers while reducing consumption of fossil fuels.

Key Findings

Continuing Work

Future Work



Distribution system upgrades are currently the highest priority item for the utility and community.

MTNT Ltd. has developed a shovel-ready plan to upgrade the electrical distribution system to a 7,200-V grid.

MTNT is actively seeking funding to support execution of the work.



PV and BESS system options would enhance community resilience against outages and support increased generator capacity. Implementing PV and BESS will require thorough analysis of the current grid state before implementation.

Detailed design of the PV and BESS system will be coordinated with the utility's pursuit of improved distribution systems.

NLR staff is using matching funding to create a digital twin of McGrath's grid to optimize an interconnection point for PV and BESS. An assessment of the impact of this interconnection will be provided to the McGrath Energy Committee and MTNT/ML&P when this analysis is complete.



A detailed resource siting assessment will provide water resource analysis to help community members understand energy potential from the Kuskokwim River.

ACEP Staff were funded to conduct a resource and siting assessment for McGrath. They traveled to the community for a summer and a fall survey and shared the data with the community.



The McGrath School is the community's designated shelter during an emergency event but does not have backup power.

A winter river survey proposal is underway to measure water speeds under the ice and create a technology-matching study.

The Iditarod Area School District allocated a 35-kW Cummins Onan genset to provide backup power. A shelter for the genset is under construction, with a foundation in place. An electrician has been contracted to install the system.

During summer, trenching of a fuel line is planned as well as connection to the building via a manual transfer switch.



Housing evaluations performed in June 2024 revealed a high energy burden on homeowners as well as health and human safety concerns from mold and indoor air quality issues.

A local woodstove changeout program has improved heating and indoor air quality concerns in some — but not all — of the housing.

In 2024–2025, McGrath will be granted funds to improve health, safety, and well-being through a United States Department of Housing and Urban Development (HUD) Healthy Homes grant awarded to RurAL CAP. However, the award isn't sufficient to cover all home energy efficiency improvements and may be dispersed only to homes meeting certain criteria. Future funding will need to be secured to address needed improvements in the wider housing stock.



The leakage rates in the city water system constitute a significant waste of produced energy.

Village Safe Water (VSW) has secured \$3.8 million for repairs of the water distribution system.⁵

VSW is currently developing a cost memo for eventual replacement of the distribution system.



The creation of an IPP could allow the community to benefit from the addition of renewable power resources without endangering its PCE subsidy.

The discussion of an IPP within the community is in beginning stages. Consensus would need to be reached between the city, the utility, and other member organizations within the McGrath Energy Committee in order to be pursued.

Figure 3. Focus area key findings, continuing work, and future work

Table 3. Focus Area Funding Strategies and Targets*

Focus Area	Potential Funding Opportunities
Distribution System Upgrades	<p>DOE OCED: Distributed Energy Systems Demonstration (<i>funding paused</i>)</p> <p>USDA Rural Development: Electric Infrastructure Loan and Loan Guarantee Program</p> <p>USDA Rural Development and Denali Commission: High Energy Cost Grants</p>
Solar and Battery Analysis	<p>DOE OCED: Energy Improvements in Rural and Remote Areas</p> <p>Alaska Energy Authority: Renewable Energy Fund</p> <p>DOE SETO: Solar Energy Evolution and Diffusion Studies (<i>funding paused</i>)</p> <p>Tax Credit: Low-Income Communities Bonus Credit Program</p>
River Energy Analysis	<p>DOE WPTO: Testing Expertise and Access for Marine Energy Research</p> <p>DOE WPTO: Hydropower Technical Collaboration Program</p> <p>DOE WPTO: Hydropower Testing Network</p> <p>DOE WPTO: Strategies to Increase Hydropower Flexibility</p>
Housing Energy Efficiency and Weatherization	<p>DOE EERE: Weatherization Assistance Program Enhancement and Innovation Grants (<i>funding paused</i>)</p> <p>DOE SCEP: Energy Efficiency and Conservation Block Grant Program (<i>funding paused</i>)</p> <p>Alaska Energy Authority: Village Energy Efficiency Program</p> <p>HUD: Rural Capacity Building for Community Development and Affordable Housing Grants (<i>funding paused</i>)</p>
Water Loss as Energy Loss	<p>Alaska DEC Village Safe Water: Capital Improvement Project</p> <p>Alaska DEC, Division of Water: State Revolving Loan Fund</p> <p>U.S. Bureau of Reclamation: WaterSMART Water and Energy Efficiency Grants (<i>funding paused</i>)</p>
Consideration of a Community IPP	<p>USDA Rural Development: Rural Energy for America Program (<i>funding paused</i>)</p> <p>ANTHC: Rural Energy Program</p> <p>USDA Rural Development: Rural Business Development Grants in Alaska</p>

*This table was compiled in early 2025 and may be subject to change

References

¹ Alaska Community Database. 2020. DCRA Data McGrath. <https://dced.maps.arcgis.com/apps/MapJournal/index.html?appid=4d2e5758a4b24db88e10ebab32b2d784#>

² City of McGrath. 2020. ETIPP Application.

³ McGrath Energy Committee. 2024.

⁴ NLR and McGrath Energy Committee. 2025. McGrath Community Energy Plan.

⁵ Village Safe Water. 2024. Information on water distribution system status provided by Oscar Menendez.



Learn more about the
U.S. Department of Energy's
ETIPP Communities

nlr.gov/state-local-tribal/communities

Cover image: Community Energy Workshop in McGrath, Summer 2023. Photo by Haleigh Reed, REAP